AMATEUR WORK

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VACUUM TUBE WINDOW DISPLAY.

OSCAR N. DAME.

As many readers of this magazine are the possessors of spark coils giving from one to two inch sparks, they will be interested in learning how, during the winter holiday season, they can utilize their coils to profitable advantage by arranging and letting to enterprising merchants the window display here described, which is exceptionally attractive at all hours except bright daylight.

In addition to the coil batteries, etc., it will be necessary to have three or four vacuum tubes, "Geissler" tubes, as they are frequently called, a few shapes being shown in Fig. 1. The smaller sizes are sold for about 50 cents each, increasing in price to $1.50 for 12 in. compound tubes; the latter giving the most beautiful floresence when excited by a coil giving a 1 in. spark. These tubes are exhausted of air and then partially filled with gases which give characteristic colors when excited by the coil. With carbonic acid gas the color is whitish green; hydrogen, white and red; nitrogen, orange yellow. The compound tubes are composed of an inner tube with the usual twists and ornamental turns, and an outer, straight tube which serves to protect the inner one against break age. This outer tube is also filled with various colored liquids which increase the luminous effect. As these tubes are almost entirely of foreign manufacture and imported by but few electrical supply houses, they will have to be ordered by mail by those not living in the largest cities.

The tubes are fitted at the ends with wire loops firmly set in the glass. They must be handled carefully, however, both to avoid breaking the glass and the outer ends of the loops. Simply mounted upon a frame with a black background, the appearance of the tubes is very fine, yet to get the best effects they should be rotated and a suitable device for doing this will now be described. Such an exhibit placed in a store window will attract much attention from passers, giving an excellent advertisement to the goods displayed in the window.

Referring to Fig. 2, the baseboard *B* is 12 in. square and ¾ in. thick. Holes for the supports, *s*, are cut 1½ in. from the front edge. These holes are 1½ x ¾ in. and are cut vertical, although the supports are inclined inward to be only 3 in. apart at the top. The supports, s, are 22 in. long, 2½ in. wide and ¾ in long, those at the bottom ¾ in. long. They should be carefully fitted and strongly secured by wedging and glue, as the revolutions of the wheel are liable to cause the frame to sway if poorly joined, the effects of which might be disastrous.

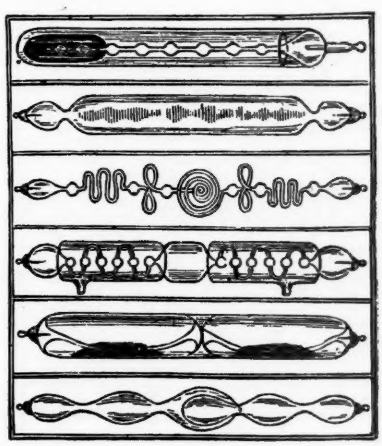
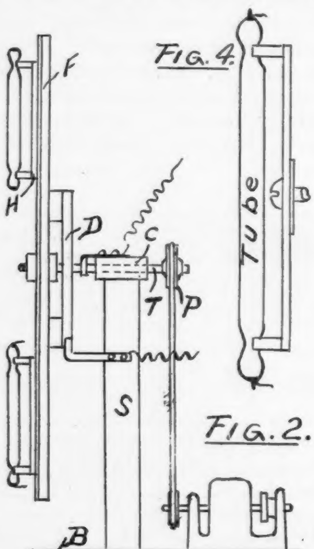


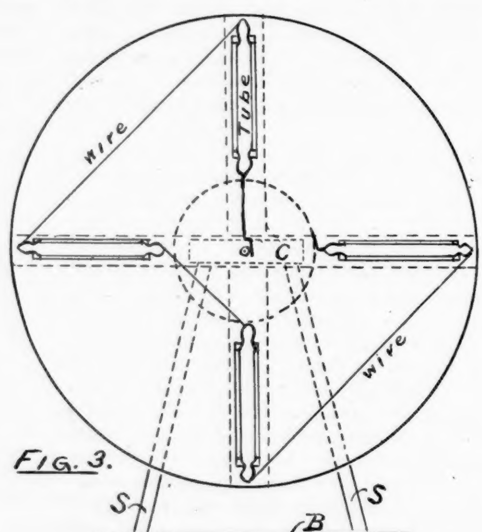
FIG. 1.

The piece *C* is 6 in. long, 2½ in. wide and 2 in. thick. Mortises for the supports are made 3 in. apart, and a hole bored through the center for the shaft *I*. This shaft is preferably made from a piece of ⅝ in. cold rolled steel, bushed with brass tubing, in which case the hole should be about 7-16 to ½ in., depending on the thickness of the tubing. Obtain the tubing before boring the hole, as it should be a drive fit. Care should also be used to see that the axis of the hole is exactly horizontal.

It will be necessary to have the outer end of the shaft threaded to receive nuts, one on each side of the revolving frame, which are screwed up hard and prevent the frame from turning on the shaft. Two collars are also needed. These can be made from the pieces of steel tubing, or $\frac{3}{4}$ in. rod, with a $\frac{3}{8}$ in. hole drilled in the center and set screws fitted to it. These are put, one on each side of the block, *C*. A pulley is mounted on the rear end of the shaft. A suitable pulley can be made of a pulley wheel used in awning pulleys and sold by large hardware dealers.

The revolving frame is made from two pieces, *F*, 36 x 2 x $\frac{3}{4}$, crossed with a halved joint. A hole for the shaft is bored at the center. At the back on each arm and 5 in. from the shaft *glue* blocks 2 x $\frac{3}{4}$ x $\frac{3}{4}$ in., and to these *glue* a wooden disk, *D*, 12 in. in diameter and about $\frac{3}{8}$ in. thick. The bottom of a peach basket will serve, or it can be cut out with a fret or keyhole saw from a board. In the center a hole is bored for the





shaft, and around the rim a band of strip brass is attached with shellac, drilling a few holes for a few short brass brads with flat heads which should be filed flat so as not to project and wear out the brushes. This brass tire should be made up and the ends soldered before putting on.

The front of the frame is then covered with thick cardboard, the front surface being black. If black cardboard is not easily obtained, use any color and cover with black paper or velveteen.

The tube holders shown in Fig. 4 are made up after purchasing the tubes, so that the fit will be accurate. The piece, *H*, is of a length to bring the two ends pieces at the narrow necks between the end tubes. The end pieces are nailed to the bottom strip, and have the outer ends cut out to fit the tube and covered with black velvet glued on. The tubes are held in place with fine wire, the ends of which are put around small wire nails put into either side of the ends. The tube frame is attached to the revolving frame by a wood screw at the center. This permits of turning the tube holders on the frame to obtain different effects when rotating.

The tubes are wired up as follows: On the top of the block, *c*, a brush is made of a strip of spring brass, 4 in. long and $\frac{3}{8}$ in, wide. A quarter turn is made with pliers at the center and then bent at right angles. Holes are drilled or punched for two brass screws, by which one end is attached to the block so that the other end will bear firmly and securely on the shaft. A flexible wire is run from one of the screws to one end of the coil secondary.

Another brush is made from a strip 9 in. long with one end bent as previously mentioned, and the other end attached to one of the supports, *S*, as shown in Fig. 2. See that the turned end bears on the rim of the disk, *D*. This end is curved so that the frame may revolve in either direction. This bearing is connected to the other secondary terminal of the coil. The tubes are then connected with magnet wire, as per Fig. 3, the wire being run on the back of the frame and brought through to the front at the ends of the tubes. Use care to run the wire between the arms and the cardboard, so that the space between the wire and the rim of the disk is as great as possible. The high potential of the current will cause it to take the easiest circuit, and it is quite necessary that the distance between wires be at least double the sparking capacity of the current.

The frame is revolved by a suitable motor attached to the baseboard as shown in Fig. 2, and connected

with a ¼ in. round belt to pulley on the shaft. Several cells of battery will be needed for current, and a switch should be placed on the baseboard to facilitate operations. The frame should be started by hand when switching on the motor, as the weight is considerable and much more power is required to start it than to keep it going.

The coil required to operate this device with four 12-in. tubes need be only about ½-in. spark capacity, as but little current is required to bring these tubes to full brilliancy. Coils of larger capacity can be used, the battery being cut down to reduce the sparking length. A little experimenting will undoubtedly be necessary to determine just the right battery power to use, being careful not to use too much and burn out the wire terminals of the tubes.

Care must also be used in wiring up and connecting to the metal tips of the tubes, as the construction is not always of the best and the tips easily break off, making connections difficult. If unused to blowpipe work and soft solder, breaks of this kind had best be repaired by a jeweller.

In addition to being an excellent window dislay, this devices makes a very interesting display for the home, and as the cost is not heavy for the whole outfit, providing the coil be home-made, those interested in coil work will find it woith the making.

CEMENT WALKS AND FLOORS.

Many farm houses have no walks about them. In too many cases only weedy paths lead to the front door and to side porches. We should plan to change these "farm houses" into farm homes. One of the best ways is to provide permanent walks—walks to the well and to the front gate; walks to the horse lot, as well as the garden. Gravel is thought to be the best material for this use, though sometimes crushed rock is available. Brick would be used more freely if less expensive. Neither of these materials makes a permanent walk.

The cheapest and best material for walks and certain floors is a concrete made of cement combined with gravel, or crushed rock, or crushed brick, and covered with cement and topping to give a durable finish. This same material may be used to great advantage as flooring for stalls in stables, dairies, graneries, etc. Such combinations, or concretes, are much cheaper than is commonly thought.

Take one part of cement to five parts of gravel or crushed brick, to form the foundation. This need be only three or four inches deep and laid flush with the ground surface or one inch above. Guide strips must be used to confine the walk to straight or regular lines. These strips of 1 x 4 or 1 x 6 laths should be laid down by careful measurement. When the foundation has begun to "set," put on one inch of topping made of two parts clean sand and one of cement. Rub the fresh surface repeatedly with a trowel to give a hard, smooth finish. When this surface has set, keep it moist for several days, laying wet sand on it to a depth of one inch.

These directions will enable any farmer or stockman to put down a permanent walk or floor if common sense be used in doing these simple things. The most durable results may be insured by repeatedly working over and mixing the cement with other ingredients, while all are dry, then wetting slowly while still working and applying in place quickly, before particles begin to set.

These concrete walks are commonly called "cement walks." After some unpleasant experience we can advise that a less expensive concrete can be made of flashed coal-tar and sand, which resembles asphalt very closely, but its application is troublesome and annoying because of its sticky properties. In any case where large, flat surfaces are to be laid with concrete, parallel guides of 2 x 4 or 2 x 6 scantling should be placed every three feet, and the mixture placed in these by belts to insure proper levels and make the work uniform in all its parts. The scantling used must be straight to permit "striking off" to a plane surface. Floors that are expected to receive water frequently, or that require many washings, must be laid with a fall of 1½ or 2 inches to every ten feet.

The tools and equipment required for laying any ordinary job of concrete are: A wooden mortar box or a smooth platform, a packing maul for firming foundation, hoes and shovels, a plasterer's trowel, a spirit level and a straight edge for striking off smooth surfaces.

Babbitt metal is an alloy of copper, tin and antimony. It is soft and nearly white, and is used as an anti-friction metal. Isaac Babbitt, of Boston, patented the alloy in 1839, and the original alloy contained 24 parts tin, 4 parts copper and 8 antimony. The following gives a tougher metal: Tin 96 parts, copper 4 and antimony 8 parts. Lead is also added in some cases on account of its cheapness. In small amounts it is not objectionable, but the Babbitt metal that is sold in the market ready mixed usually contains a considerably larger proportion of lead than its price would indicate. The alloy is usually melted and run, while fluid, directly into the bearings, a space from an eighth to a half inch thick being left for it between the box and the shaft that is to be supported.

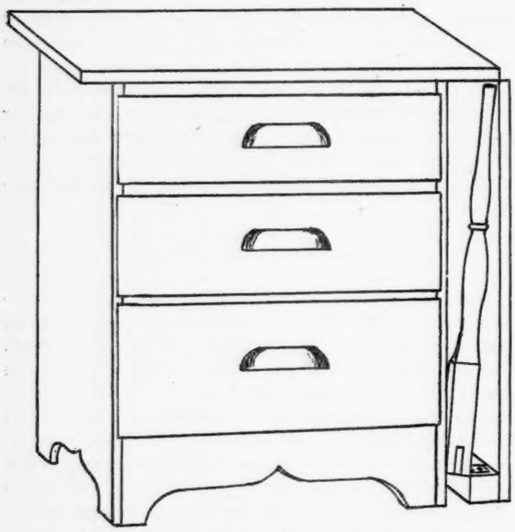
When the electrification of the railroads which run under ground in London is completed the traveller will be able to traverse 60 miles under ground by electric traction without running twice over the same piece of track.

A SEWING CABINET.

JOHN F. ADAMS.

The amateur cabinet maker should, whenever possible, lend his skill and labor to the making of furniture which will be serviceable to the gentler part of the family, thereby making easier and more agreeable the manifold duties incumbent upon them in most households. The sewing cabinet here described will be found of great convenience by those of our fair friends who have much sewing work to do, as it provides receptacles for the storage of the many articles needed in such work, as well as a large surface for marking and cutting out patterns.

The illustrations show the general construction of the cabinet. The folding end can be made without difficulty the legs being made from two stair banisters. The fronts of the drawers differ slightly from those described in previous articles, the edges of the front overlapping the frame and rounded off on the outer face.



For the top, including the part which drops down, there will be needed pieces which when glued up will measure 38½ x 19 x ¾ in. After gluing up, this is sawed into two pieces, the top being 25 in. long, and the drop 24½ in. The top projects 2 in. at the left and 3 in. at the right. The two sides are each 25 x 18¾ in. The bottom ends are sawed out on a band-saw to the scrolls shown. If a full size pattern be drawn and taken to the mill when the lumber is ordered, this sawing, as well as that on the piece at the bottom of the front, which is the same pattern, may be cut out at small expense, saving much time and labor.

The piece at the bottom of the front is 17½ x 5¾ in., the opening being 13½ in. long. This is attached to the sides by 1½ in. screws, countersinking the heads. A cross-piece 17½ x 3 in. is put across the back, attaching to side in the same way. Before putting in place, however, this latter piece should have a ½ in. rabbet cut in the upper, outer edge to receive the backing, which is of ½ in. matched sheathing.

The runs for the lower drawer are strips 16½ x ¾ x ¾ in. After coating one surface liberally with glue, attach to the sides with three screws in each. Use care to see that the top edges are even with the tops of the division pieces between the drawers, which are 17¾ x 1 x ¾ in. These are nailed to the ends of the runs, and nails are also put through the sides. Use wire nails for this work. A similar piece is placed between the upper drawer and the top.

As previously mentioned, the fronts of the drawers lay the frame ½ in. all round. Much work may be saved in making them if the necessary rabbets are cut out at the mill when the lumber is obtained. The front of the lower drawer is 18 x 8, the middle one 18 x 5½ and the upper one 18 x 14½. On the inner sides of the upper and lower edges of these fronts cut rabbets ½ in. deep and ¾ in. wide, allowing for the use of ½ in. stock for the sides of the drawers.

The sides of the drawers are 17 in. long and ½ in. less in width than the fronts. The front ends are placed in the rabbets at the ends of the front pieces, and securely nailed in place. The rear ends of the drawers are 19 in. long, and the same width as the sides. The bottoms of the drawers are fitted within the sides and securely nailed. The outer edges of the fronts are then quarter rounded with a plane smoothing off with sand paper.

A strip of wood ¾ x 1 in. is then nailed to the under side of the top, at the back, being set in ½ in. from the rear edges of the sides. To this strip, nail the top at the back, being set in ½ in. from the rear edges of the sides. To this strip, nail the top ends of the sheathing, which can now be put on.

The drop leaf can be greatly strengthened by means of cleats at the ends, which should be 1½ x ⅝ in. First cut out rabbets on the under side of the board, and carefully fit the cleats, which should be both glued and screwed into place. At the lower, inner end a piece 17 x 1½ in. is attached, to which the legs are hinged. This piece may be glued up from two piecs ⅜ in. thick.

The legs are made from two stair banisters, which may be obtained of suitable pattern from any carpenter's shop. The top ends are cut off at the place most suitable to make the legs symetrical and 23 in. long.

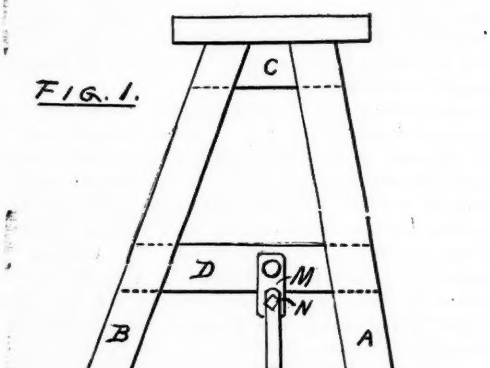
In the square ends now remaining and forming the tops of the legs, cut mortises for a cross piece, which should be 17 x $2\frac{1}{2}$ x $\frac{3}{4}$ in. The tenons on this piece should be $\frac{1}{2}$ in. thick leaving a $\frac{1}{8}$ in. shoulder to give rigidity. Secure the joints with dowels and glue.

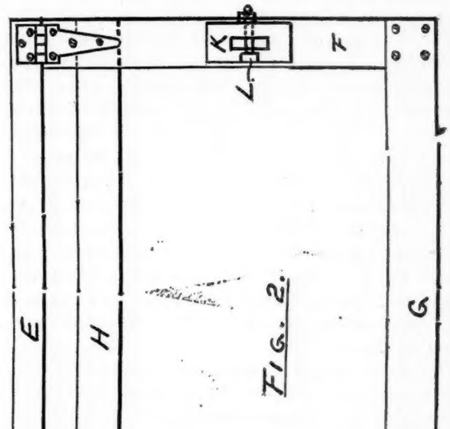
In attaching the legs to the piece at the bottom of the drop leaf, the joints of the hinges are placed $\frac{1}{2}$ in. out from the piece, which serves to give the right height to the outer end of the leaf when raised. A hook and eye on the leg frame and cross piece will keep the legs in place when the leaf is up. The hinges at the upper end of the leaf are sunk into the wood the thickness of the hinges to prevent a wide crack when the leaf is down. The finish should be fairly dark, and if made of any light colored wood the stain should not be too thick, followed by a dark colored filler. This will give a uniform dark finish and yet bring out the grain. The coats of shellac varnish followed by a coat of varnish will give a durable wearing surface to which cloth will not stick after it is thoroughly dry.

FOOT MOTION FOR BENCH LATHE.

FREDERICK A. DRAPER.

The amateur who possesses a bench lathe does not always find it convenient to operate it by power and is obliged to either purchase or make a foot motion for driving it. Those who prefer to make one will find the design here described easily made with but little machine work, and this can be done by any blacksmith possessing a drill, or by a machinist, as it consists only of the drilling of a few holes and threading some of them. The dimensions are suitable for the Amateur Lathe.





The wooden frame, shown in Fig. 1, is made of 2 x 3 in. spruce, and when planed on all sides will measure $1\frac{3}{4}$ x $2\frac{3}{4}$ in. The two pieces, *A*, are 30 in. long before the ends are cut to the angles to fit square on the floor, and to the top. The outer edges are distant from the vertical line of the driving shape, at the top 4 in. and at the bottom 9 in. The two pieces, *B*, are 32 in. long, and distant from the shaft line, at the top 4 in. and the bottom 15 in. The object in throwing out the bottom of these pieces is to give a longer treadle arm, thus securing a shorter throw, in this case 8 inches.

The two pieces, *C*, at the top are $9\frac{1}{2}$ in. long before cutting to the angles of the legs. They are mortised into the legs, care being used to get them to fit well, as poor fits will mean a wobbly frame. The pieces, *D*, are 16 in. long, also mortised to the legs with the upper edge $12\frac{1}{2}$ in. from the top of *C*.

The legs, when framed up as above are $24\frac{1}{2}$ in. apart, and as the piece, *E*, projects beyond them 3 in. at each end, this piece is 34 in. long. It is halved into the

legs with the top edge 4¾ in. from the floor. Note that it is also at an angle with the pieces, *B*, which is to avoid cutting out more than is necessary to make a firm joint. This piece is attached to the legs, *B*, with large wood screws, countersinking the heads.

The treadle frame is shown in Fig. 2 and is made of selected spruce or oak, ¾ in. thick. The former is the more desirable, making a lighter frame. The two pieces, *F*, are 24 in. long and 3 in. wide. The piece, *G* is 34 in. long and 3 in. wide. It should be firmly attached to the outer ends of the pieces, F, with several wood screws, countersinking the heads. The piece, *H*, is 34 x 2½ in. and fastened to the under sides of the pieces, *F*, with screws, the inner edge being spaced 1 in. from the ends of *F*.

Two pieces, *K*, of 2 x 3 spruce 5 in. long are fastened to the upper sides of the pieces, *F*, after cutting out holes for the treadle rods, *R*, Fig. 1. Long wood screws or bolts are used for fastening these pieces, as all the pull of the treadle comes upon them, and they should be well secured. Holes are bored through the centers of these pieces for the bolts, *L*, holding the treadle rod. These bolts are 3 x ½ in., square holes for the heads being cut on the inner sides of the blocks.

The treadle frame when finished is attached to the piece, *E*, by two heavy tee hinges, which should be carefully placed so they will work without binding. The top is a piece of spruce plank 12 in. wide and 36 in. long attached to the frame with strong screws.

The shaft is 31 in. long and 1 in. diameter. This can be obtained of any dealer in shafting and will need no machine work. At the ends are two arms, *M*, 4 in. long and 2 in. wide and ⅜ in. thick, made from bar iron or steel. A 1 in. hole is drilled at one end and a ⅜ in. hole at the other, the centers being 2 in. apart. The smaller hole is tapped for a 1 x ½ in. machine bolt, *N*. After fitting the arms to the shaft, drill ¼ in. holes and taper out with a taper reamer for a taper pin to key the arms to the shaft. Or a keyway may be cut with a cold chisel on the shaft, and a slot in the arm and a key fitted. Before finally fastening the arms in place, the drive wheel, *W*, is fitted to the shaft and also keyed in place.

The drive wheel is located just inside the left legs. Holes must also be bored in the cross pieces, *D*, to receive the shaft. These holes should be large enough to receive a bushing of brass or drawn steel tubing with a drive fit, the size of the hole depending on the thickness of tubing used. The drive wheel can be made of two thicknesses of 1 in. board, fastened together with glue and screws, and with the grain of each layer crossed, or can be of iron, if one can be purchased with the steps spaced correctly for the lathe.

The treadle rods, *R*, are made of bar iron or steel, and are 12½ in. long, 1¼ in. wide and ⅜ in. thick. Holes are bored at each end for the studs, *N*, and bolts, L, the centers being 11 in. apart. The holes should have easy fits. The top hole can also be made 1½ in. lon by drilling two more holes below the first one and filing out between. This will allow the treadle to lift should the foot be accidentally placed under it, and thus save being squeezed, as the treadle almost touches the floor. Anyone who has had a toe nipped with a treadle in this way will readily appreciate the value of having these slots. No mention has been made of oil holes as, if the lathe is used but little, oiling can be done from the sides of the bearings. It is advisable, however, to drill holes down through the pieces, *D*, and the bearings, so that the shaft can be oiled.

The reader is also cautioned to see that the drive wheel is fitted to the shaft with the steps the right way to receive the belt. As the weight of the treadle will cause the drive wheel to come to rest with the treadle down, a counter weight can be riveted to the wheel to balance the treadle and prevent this back motion, which on some work might prove bothersome.

DURABLE WHITEWASH.

The complete success is well known of the formula for whitewash adopted by the United States Government as a coating for lighthouses, and for its effectual prevention of any moisture striking through the walls. It is simply the mixing with fresh water, in the most thorough manner, of three parts Rosendale cement and one part of fine clean sand, thus giving a gray or granite color, dark or light according to the color of the cement; if a very light color is desired, lime is used with the cement and sand; if brick color is sought, enough Venetian red is added to the original mixture to insure that result. Care is exercised to have the various ingredients well mixed together—also, in applying the wash, to have the wall wet with clean, fresh water, followed immediately with the cement wash—this method preventing the bricks from absorbing the water from the wash too rapidly, and it also gives time for the cement to be properly set. The mixture is made as thick as can conveniently be applied with a whitewash brush in the usual manner, and the wash is well stirred during the process of its application. It is stated, however, that though this mixture is so admirably suited for the purpose in question, it cannot be used to advantage over paint or whitewash.—"Kuhlow's."

The rolling stone may gather no moss, but it knows a heap more than the stone that remains eternally in one place; a thought that occurs to the human traveller when he realizes the broadening, educating and uplifting influence of travel upon him. The best substitute for travel is the careful reading of well-selected books and periodicals; but both reading and travel are necessary to an intelligent understanding of the world and its people.

FACTS CONCERNING PATENTS.

A Paper read by Mr. F. W. Winter befo.e the Mechanical Section of the Engineers Society of Western Pennsylvania.

Engineers should have a general knowledge as to what rights they have in inventions made by themselves, or by those associated with them, the manner of securing and enforcing those rights and, in general, to be in possession of such information on the subject as to be able to act advisedly in regard thereto.

Basis of our patent system. The patent statutes of the United States are based upon Article 1, Section 8, of the Constitution, which provides that Congress shall have the power to promote the progress of science and useful arts by securing for limited times to inventors the exclusive right to their respective discoveries.

This constitutional provision gives the underlying principle of our patent statutes, and shows that the reward of the inventor is not the primary object aimed at. But it is a necessary incident. The framers of the Constitution perceived that the progress of science and the useful arts could best be promoted by furnishing an incentive to make improvements, and that the best incentive is some personal reward or advantage to the inventor. Accordingly an inventor for a certain period is given an exclusive right to his inventions and discoveries, that is, a monopoly. As a consideration he is required to describe and illustrate the invention in his patent specification and drawings so fully and clearly that a person skilled in the industry to which the invention relates can make and use the invention; to the end that after the monopoly has expired the public will be able to use and derive benefit therefrom.

Therefore an inventor applying for a patent must disclose his entire invention, the principle thereof, and the best manner of applying the same. He cannot withhold any part thereof; otherwise the patent will be void. If he wishes to keep the whole or any part of his invention secret, the patent statutes give him no aid. This statement is ventured because the writer has been asked to secure patents for inventions which the inventors did not care to disclose fully even to their attorney. Clearly all such efforts are futile.

What is patentable? The statutes provide for the grant of patents for new or useful arts, machines, manufactures, compositions of matter, improvements and designs.

The term "art" covers what are ordinarily known as methods or processes where the improvement consists in the manner or mode of accomplishing the result, as distinguished from the mechanical appliances necessary for this purpose.

The term "machine" is self-explanatory.

The term "composition of matter" covers all mixtures of several ingredients whether chemical combinations or mechanical mixtures. Soaps, powders, paints, etc., are examples of well-known compositions of matter.

A "manufacture," in the meaning of the patent statutes, is anything made by the hand of man and which is subject to manufacture and sale. This term is a broad and elastic one, and the interpretation given to it by the courts bring within it the inventions which cannot properly be classified under the other heads.

The term "improvement" in the statutes is largely superfluous, for in a sense every improved device is a new device; or, vice versa, most new devices are merely improvements over prior devices. In the history of our patent system there have been but few generically new devices or processes.

The inventor need not concern himself under which one of the statutory classes his invention belongs. Neither do the patent offices and the courts concern themselves with this question, it being sufficient that the invention is new, and that it marks an advance in science and the useful arts. The statutory classes of mechanical inventions will be stretched to cover it.

The term "design" in the patent statutes has a different meaning from what it has in engineering, where it is often used to mean a new plan or arrangement of mechanical parts for getting new or improved functions. For instance, a new design of motor is a new motor.

All such matters in the eye of the patent statutes are subjects for mechanical and not for design patents. The term "design" in the statutes is limited to matters of ornament or configuration appealing to the æsthetic sense, and not to utility; such as a new design for spoons, jewelry, vases and the like.

Utility. An improvement to be patentable must be useful. This does not mean that the device must be more efficient or economical than prior devices of the same kind. The degree of utility is not inquired into by the patent office.

If a device is incapable of producing any results whatsoever, it is inoperative and not patentable. So, too, if the device is injurious to the morals, health or good order of society, it is not useful within the meaning of the patent statutes. Upon this ground the patent office refuses to grant, and the courts refuse to sustain patents for deleterious compositions and compounds of food products and the like, and for devices which can be used only for immoral or unlawful purposes. The more completely such an invention could perform its functions the more objectionable it would be for want of utility.

If, however, a device is capable of a good result it is patentable, even though it may be used for some un-

lawful or immoral purpose. The evil in such case is not inherent in the invention, but it is a fault of the user, for which the latter, and not the inventor, is punishable.

Subject to the exception in regard to the utility of an invention, it is a general rule that all changes or or improvements, whether mechanical electrical, chemical, structural, or otherwise, in a method or process, tool, machine, appliance, device, manufactured article or composition of matter, in all arts are patentable providing they are new and are the result of invention. The statutory classes of invention have been given a sufficiently broad and elastic interpretation to cover the whole range of human activities and industries.

Invention. As to what constitutes invention no general rule can be laid down. There are many improvements which are the natural result of the advancement of an industry and which are suggested by many persons whenever the occasion demands. There also are many changes which are merely the expected skill of an ordinary mechanic working in those lines. All such changes are not "inventions" within the meaning of the patent statutes and are not patentable.

In general, invention may be said to consist in bringing forth that which theretofore was hidden to persons skilled in that particular art. The amount of change necessary to constitute invention may be very small, or may be required to be quite radical, depending upon various factors, but principally upon the advantages and results following from the change. If the benefits are very great, and the public and manufacturers are anxious to adopt the improvement as soon as shown, it will be held to show that even a very slight change was the doing of something which before was hidden, and hence to be an invention. On the other hand, where there is no marked resulting advantage the courts require a greater degree of change in order to find the presence of invention.

Novelty. The question of the newness or novelty of an invention is purely one of fact and one upon which no opinion can be expressed without a detailed knowledge or examination of the art to which the invention relates. Under the statute, an invention is not new if it was:

1. Patented in this or any foreign country before the applicant's invention or discovery thereof, or more than two years prior to the application for patent.
2. Described in a printed publication in this or any foreign country prior to such invention or discovery, or more than two years prior to the application.
3. Known or used in this country prior to such ininvention or discovery, or
4. In public use or on sale in this country for more than two years prior to the discovery.

It follows that knowledge or use of an invention in a foreign country does not affect a patent granted in this country, unless such invention was either patented or described in some printed publication.

Novelty can be determined only by an examination of all prior patents, publications and uses in the same and analogous classes of inventions. This, to be thorough, covers a very wide range.

Term of patent. All mechanical patents are granted for the uniform term of 17 years. This is not now affected by the existence of any prior shorter term foreign patents for the same invention, the only requirement being that if a patent is first taken out in a foreign country the application in this country must be filed within 12 months after the filing of the foreign application. The term of 17 years can be extended only by a special act of Congress, and this has not been done in any case, and is not likely to be done.

In case there is a material error in the patent, or if it is inoperative or invalid by reason of a defective or insufficient specification or claim, it may be reissued, but such reissue patent will continue in force only for the unexpired term of the original patent.

Design patents are granted for terms of 3½, 7 or 14 years, at the option of the applicant. He must make his selection of the term at the time he files his application. It cannot be made thereafter.

The right granted by patent. All patents give an exclusive right during the term of the patent to (1] make, (2) use and (3) sell the invention covered there by. Infringement, therefore, may occur either by making, or by using, or by selling the device. Where one party manufactures a patented device, another party sells it, and a third party uses it, they are each liable for the entire enfringement, and the patentee can choose which of the three he will use, thus being able to respond in damages.

Patent rights extend to all of the United States and territories, but not beyond the same. Vice versa, patents granted in foreign countries give no protection in this country. Therefore it is no aid to the protection in this country to also take out patents in foreign countries. The seller or user in this country of an article manufactured abroad will be liable for infringement of any United States patents covering said article.

A patent gives an exclusive right only for that which is distinctly claimed. If no sufficient claim is made, the courts will give no relief, even if the invention is exceedingly valuable. The utmost care should therefore be exercised in drawing the claims of a patent. It is possible to so restrict the claims for a very valuable invention that it will be easy for others to devise forms of apparatus which accomplish the same result but do not infringe the patent. The claims should cover all possible mechanical embodiments of the principle of the invention, so that others, even though they originate new mechanical constructions or combinations, cannot avoid infringement.

Patent claims usually are drawn to combinations of the various elements which constitute the new device. Infringement does not exist unless all elements

of the claims are employed by the defendant. In other words, the combination of a claim must be used in its entirety or else infringement does not exist. It is therefore essential that the claim, or at least the broad claim, should contain no element of limitation which is not absolutely essential to the principle of the invention. Brevity in patent claims is desirable.

The monopoly does not begin until the patent has actually issued. While the application is still pending in the Patent Office, the inventor has no right to sue others for infringement.

CONCLUDED IN THE OCTOBER NUMBER.

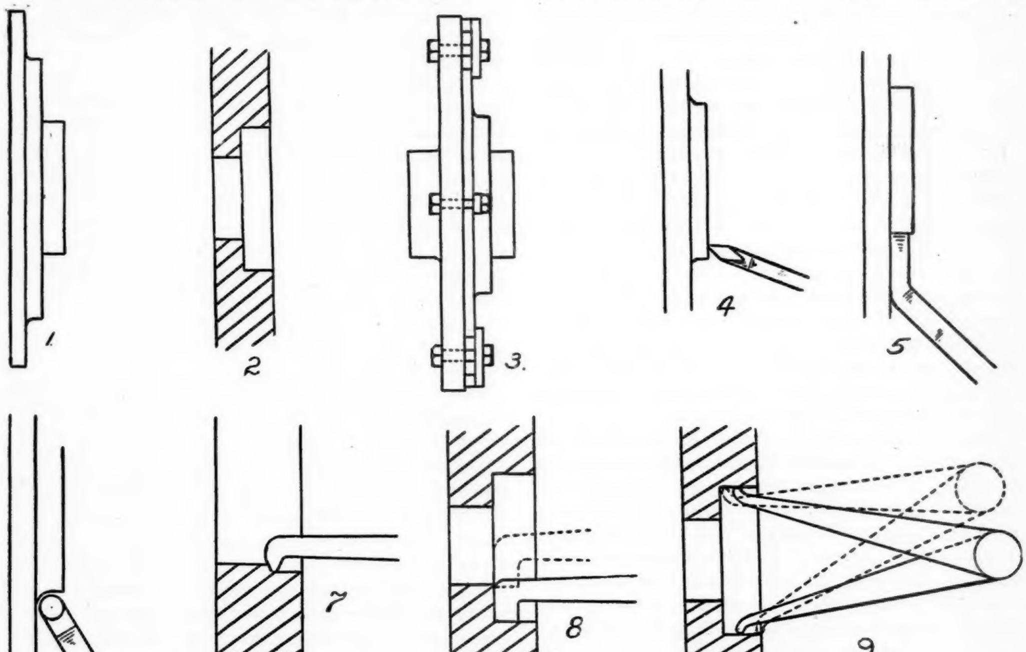
THE METAL WORKING LATHE AND ITS USES.

ROBERT GIBSON GRISWOLD.

V. Facing and Boring.

For truing up flat surfaces, the piece to be operated upon is strapped to the face plate either directly in contact therewith or, if it has one finished surface, it is laid on two parallel strips which insure this surface being exactly parallel with the surface of the face plate.

But before going further it is well to know whether the face plate is true; that is, whether it is a true plane, and whether the tool travels across the carriage in a line exactly at right angles with the center line of the lathe. If it does not it will be an extremely difficult operation to true up the face plate, or to make a good job of the work strapped to it. But assuming that the face plate is reasonably true, we will consider the steps in facing a bass on a rough, flat casting, like



that shown in Fig. 1, and boring a hole through it, having a shoulder about half way through, as shown in section in Fig. 2.

The operation of strapping the the pieces to the face plate is more readily performed if the plate is removed from the spindle and laid on the bench. Strapping work to the plate while in the lathe is a laborious op-

eration excepting when the piece can be held against it by the tail center.

After running a file over the back to make the surface reasonably flat and free from small projections, it is placed against the face plate with a piece of paper between. The object of this paper is to prevent the shifting of the piece when the tool takes a cut. It affords greater friction between the work and the plate. Three or four clamps are now set up against the piece, these clamps being simple straps of say $\frac{1}{4}$ x $1\frac{1}{4}$ in. flat iron with a hole through them for the bolt, as shown in Fig. 3. These bolts are first set up so as to clamp the piece firmly against the plate, but not so that it will not move when struck on the edge with a hammer. The piece is now ready to be centered.

When placing it on the plate it is centered as nearly as possible by eye, but the final adjustments are made in the lathe where the piece can be rapidly revolved. After screwing the face plate home the work is set in motion either by putting the belt on, running by power at a slow speed, and a piece of chalk is held in the hand and up against the edge of the work. The hand or arm rests against some solid part of the lathe, generally the tool part or carriage, and the chalk is just allowed to touch the high spots. When the work is stopped it will be found to bear chalk marks on the "high side" or on the side furthest from the center. It is quite obvious, therefore, that the piece should be moved slightly to the opposite side, and this is done by gently tapping it with a hammer. The chalking process is again repeated and the work moved until it is truly centered. Then the clamps are set down hard, care being exercised to see that the work is not moved during this operation.

The question as to whether the tool should be fed in towards or out from the center of the work is hard to decide, as this question, too, has its opponents. It is frequently decided by the character of the work itself, as the position of a shoulder on the face will determine in which direction the tool must be fed.

But in this case we will feed the tool in toward the center. A diamond point tool is the proper one to use first, setting it on an angle, as shown, and grinding the point so that it has a left-hand top rake. A point to be remembered in all work of this kind where castings are to be machined, is that the surface of a casting is very hard and that this "skin" or scale is very apt to take the edge off a tool even at a low cutting speed. Sometimes it seems almost impossible to make the tool penetrate below this skin, in which event it is well to score the edge about to be cut with a cold chisel. This breaks the surface and allows the tool to get under the scale.

When the roughing cuts have reduced the piece to within a few hundredths of an inch of finished dimensions, the side tool is put in and the finishing cuts are made with a sharp corner. A right-hand offset cornering tool must be used, as shown in Fig. 5. If a round fillet is required, a round-nose tool is used, as in Fig. 6.

Supposing the piece has now been finished in size, boring the hole next commands our attention. A centering tool is now placed in the post and a center bored in the face of the piece just deep enough to start the drill. A drill slightly smaller than the finished size of the hole is then set in the cup just bored, and the small center hole in the opposite tapered or stock end of the drill is placed on the drill to prevent its turning, the tail of the dog resting against the tool carriage.

When the hole has been drilled completely through (and right here is one reason for placing the work on parallel strips. If the hole to be bored is smaller than the topmost hole in the spindle, the drill and tool will not touch it, but if larger, the work must be mounted on strips that will allow the points of the drill and the tool passing completely through without touching the face plate) the drill is removed and the boring tool placed in the post. It is fed into the work with a small cut and fine feed, the tool being gradually fed out until the hole is finished exactly to size. The boring tool always cuts on the front edge and should be so ground as to present only a small cutting surface; the tool, owing to its shape, is not very stiff and if a broad cutting edge is used considerable chattering will surely occur.

But this hole is shown provided with a shoulder about half-way in. The first hole bored is the size of the smaller one. The tool is then fed out so as to enlarge the hole, and this cut is run in until until say 1-32 in. of finished depth and a few hundredths of an inch of finished diameter. Then the point of the tool, or better still, another tool kept especially for such work, is ground with a square corner and the finishing taken with this. Make the bottom cut by feeding the tool towards you rather than towards the face-plate, as the latter method presents a broad cutting surface, while the former takes only a small cut on the advancing edge of the tool.

This finishes this particular piece. In calipering the diameter of the hole, do not allow the calipers to drop below center, but measure the hole with the calipers standing as nearly perpendicular to the surface of the work as possible, as shown in full lines, Fig. 9, and not as shown in dotted lines.

From data recently published in connection with the present tendency in American colleges towards engineering as compared with arts it is found that, taking 18 of the leading institutions which offer courses in arts, sciences and engineering, the ratio of increase during the past four years has been but 15 per cent, even though these courses include practically all of the women students. As against this increase is set that for engineering, which is no less than 102 per cent. The figures include only regular students and seem to form one of the signs of the times.

GAS ENGINE ECONOMY.

The question of economy in the consumption of fuel is of great importance to the purchasers of gas or gasoline engines, and incidentally to the manufacturers of these engines also. For, all things being equal, the firm that builds the most economical gas engine in the way of fuel consumption, or, in other words, that gives the best results for dollars expended, will get the largest amount of business, and as a corollary thereto, the greatest number of dollars. The question now arises, How shall we get the greatest amount of power out of a given sized engine with a given amount of fuel?

After having spent several years in studying this question and making experiments, and during that time having also built a large number of gas and gasoline engines, the writer of this article is firmly convinced that the position of the igniter in its relation to the charge of gas in the cylinder has far more to do with the economy of gas engines than is generally understood. It is a well-known fact that the charge of gas and air in the cylinder of an engine in operation is more or less stratified; that is, the air and gas are not thoroughly mixed, but portions of the charge are rich and others poor in gas. Someone might ask what difference this makes. When the explosion occurs the charge is entirely consumed and the piston receives its impulse from the expanding gases. The answer to this is: "All the difference between high and low economy in the consumption of fuel." If the charge is ignited at a point where it is rich in gas, the explosion is very sharp and strong and gives an injurious shock to the engine. The exhaust also is liable to be smoky, resulting in a loss of power. If the charge is ignited at a point where it is poor in gas, the explosion is too weak, resulting also in the loss of power, to overcome which the engine is fed more gas or gasoline with a consequent loss in economy. This argument is based on the assumption that the engine was at first fed the proper amount of gas and air to give the most efficient service. Now there are one or more parts of the indrawn charge where the air and gas are in exactly the right proportions. If the igniter can be brought in contact with the charge at this part, the result is the greatest economy and efficiency.

It has been said by a prominent writer on gas engines that in designing a gas engine we can never be sure beforehand what the results will be. He says that an engine of given dimensions should develop a certain horse power, but when the engine is built and put in operation the result may be very disappointing. In other words, the whole science of gas engine building, according to the writer, is a mere matter of guesswork. Now I contend that this is wrong,—the science of gas engine building should be as exact as is the science of steam engine building. Imagine a man of today experimenting on steam engines in order to find out what size is required to run a certain plant! It is not for one instant claimed that the builders of gas engines have not advanced scientifically and intelligently in the working of gas engines, nor do I claim that the placing of the igniter in the proper position on the cylinder would put this industry among the exact sciences, but I do claim that it would make a great advance toward that end.

When a change of gas and air enters the cylinder, it is more or less thoroughly mixed and position of the inlet valve and also by the shape of the cored passages so that the richest part of the charge will vary more or less in position in the same type of engine, giving more or less economy, unless the passages are machined of an exact size or very carefully molded. Competition is too keen nowadays for manufacturers to enter carelessly into these details. The chief trouble however, with most gas engine ignition does not lie in any inaccuracy in the inlet passages, but in the fact that the igniter is put in "any old place." As long as the charge ignites, some manufacturers—and their name is legion—think the engine is all right, not knowing that it is on the proper placing of the igniter that the engine mainly depends for its efficiency and economy. It is this false policy that has brought the gas engine rather into disrepute and lessened its sale. The writer is convinced that if this matter were properly attended to, and the scientific placing of the igniter more thoroughly understood, it would result in a greatly increased sale of gas engines. Some makers claim that the best point of ignition is right in the center of the charge, so as to ignite it in its entirety as rapidly as possible, but, as we said before, this depends upon the richness of the charge at that point. Moreover, the same principle should be applied to gas engines as is applied to guns. A small engine, like an army rifle, should have a sharper and more sudden explosion, a cannon, should have a slower explosion, corresponding to the slow-burning powder used in large guns. This makes them run smoothly and without shock.

The explosion of the cylinder is of an exceedingly high thermal efficiency, but it lasts only a short time and drops quickly to a very low point. In small engines of high speed a large amount of firing lead should be given, so as to take advantage of this high efficiency at the proper moment and not explosion and loss in heat units is also very sudden, and unless advantage is taken of these facts there is a great loss of power. As the engine increases in size the explosion and combustion of the charge must be slower, and the point of highest thermal efficiency must receive a sudden and severe shock that is very injurious to the working parts. If it is sought to overcome this by giving the engine less lead, the result will be loss of pow-

er. Now some manufacturers go ahead blindly and put the igniter in the same relative position on all their engines, irrespective of design or size, with the result that a few run over and a large number run under the expected horse power.

Let me here give an experience that came under my personal notice. A certain shop in Canada had been building gas engines designed by an expert. The igniter was directly on the top of the cylinder, since the gasoline vapor, being heavier than air, would not rise to the igniter. It was therefore decided to place the igniter as low down on the side of the cylinder as possible, which as can readily be seen, was an even worse position than the former, for I found by actual test that the consumption of gas was greatly increased. Several of these engines with the low igniter were built and sent out and shortly after returned to the shop because they used too much gas.

Although the igniter in its new position was far closer to the inlet valve, yet the charge passed by the igniter and became stratified in another part of the cylinder, leaving the part around the igniter very poor in gas. To overcome this, it was decided to place a hood inside the head, over the inlet valve, in order to deflect the charge against the igniter. What was the result? The charge at the igniter was so rich in gas that when the explosion occurred it was so early and severe that the shock in the engine could be heard quite a distance away, and would soon have made the engine fit only for the scrap pile. The only thing to do in this case was to give very little lead to the engine with a consequent loss of power. At my earnest solicitation the igniter was raised up a little and we had a test of the two styles. Both engines were of the 8-in. bore and 16-in. stroke. The engine with the low down igniter was running a chopper and all that could be got out of it was 15 bags of chop an hour with the engine loaded to its limit. We removed that cylinder and replaced it with one that had the igniter raised.

At the first test with the engine we chopped 34 bags of chop in one hour, and at a second test we chopped 32 bags in one hour. In this latter trial the engine was not loaded to its limit, so could have done even better, and this was accomplished with nearly 25 per cent less gas than the other style of cylinder required to chop 15 bags. I also took a brake test of the engine with the igniter raised, and it gave 24.4 h. p. Not a bad showing for an engine of that size.

If it were possible to build a four-cycle engine in which the charge could be thoroughly mixed before ignition, the question of the position of the igniter would not be of nearly so much importance. But engines are now built to run at two, three, or four hundred revolutions per minute, and competition being so keen, the question of cheapness of manufacture is of vital importance. Attempts more or less successful—generally less—have been made to overcome the difficulty, but most manufacturers and purchasers of gas engines want them as simple as can be made and with as few clap-traps as possible. This being the case, the writer is convinced that the only way to get the maximum amount of power with the minimum consumption of fuel is to place the igniter on the engine according to the size of the engine and the design of the inlet valve and passages, so that the charge that comes in contact with the igniter will be of the proper mixture for each particular size and design. When this is done a gasoline engine will run as smoothly and quietly as a steam engine, without the slightest shock and with the added advantage that there will be a considerable increase in power, and a greatly increased economy in the consumption of fuel over present makes of gasoline engines.—"Gas Power."

FROST ON SHOW WINDOWS.

During the winter months many shopkeepers experience more or less difficulty in keeping their windows free from the ice that in low temperature tends to defeat the object of the display. No doubt all of the devices for keeping glass clear of ice, published from time to time in the journals, have received a fair test with varying satisfaction. A writer in one of the foreign drug journals, apparently a druggist who has experienced the rigors of high latitudes, insists that none of the ordinary schemes are of much use, and that the only certain remedy for the opaque deposit of solid water is a double layer of glass with a sufficient air-space between. He states that the applications of glycerine, alcohol and other solutions are of no avail in extreme weather, and that, in any case, they must be so frequently renewed that they become extremely troublesome.

In the northern portions of Russia, where zero weather is sufficiently common, experience has taught the owners of show windows that the only effective protection is a three-inch air space between two panes of glass. The outer sash is rendered as nearly tight as possible by calking the chinks and pasting strips of paper over the crevices. The glass is then carefully cleaned and dried on a clear, mild day, and a second sash fitted with the same care to prevent all circulation of air, is inserted about 3 inches within the first. The double panes are said to obstruct the view very little. The physical cause of the deposit of moisture and ice upon windows is the difference in temperature between the surface of the glass and the air bearing a relatively high proportion of moisture, which comes in contact with it.—"Scientific American."

The famous Liberty Bell was cast in England and was brought from there in 1752. While being taken from the ship it was injured, spoiling its tone, and was recast in Philadelphia in 1753. It was broken in 1835 and has remained in that condition.

A TAILLESS OR MALAY KITE.

CHARLES B. GILMORE.

Kite flying has, within recent years, progressed beyond the field of affording amusement for boys and is now frequently used for both scientific and useful purposes. As a means of exploring the lower air currents, and for photographic purposes, the box kite has a well recognized place. The Malay, or tailesss kite is also a useful form, and is frequently used tandem for reaching high altitudes, for which purpose it is well adapted. To attain success in flying this kind of kite requires that it be accurately proportioned, well constructed, as well as designed for the particular strength of wind in which it is to be used.

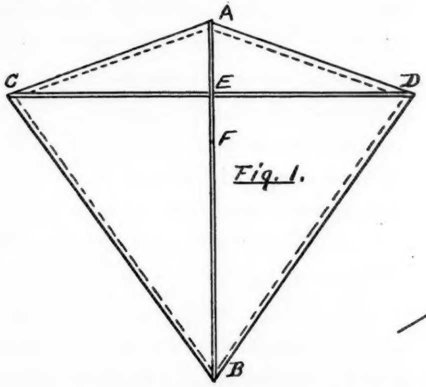


Fig. 1.

Dimensions will be given for two sizes, so that anyone caring to build one can select the size best adapted to his needs, but several trials may be necessary before satisfactory operations will be secured. Even then the kite may have a tendency to be erratic until high enough to reach steady winds; the lower currents ordinarily being rather gusty.

For a kite five feet high, the frame, as shown in Fig. 1, is as follows: The piece *AB* is 5 feet long and *CD* 5 ft 8 in. long, each made from spruce strips ½ x ⅝ in. See that these strips are perfectly straight grain and of uniform thickness. The piece *AB* is sometimes made of bamboo, which is both light and strong. If made of spruce, the strips may be planed down from the joining point *E* to a thickness of ¼ in. at the ends, which reduces the weight without loss of strength.

The piece *CD* must be worked until it will bend backwards with a uniform curve, as shown in Fig. 2, so that the curve will be about one-tenth of the length of the piece, or 6¾ in. A wire guitar or mandolin string can be used as a bowstring, considerable strength being required. Wire has the advantage over cord of not stretching should it rain while out and no shelter be at hand.

The bow being completed, it is lashed to the piece *AB* so that the space *AE* will be about 18 per cent of the length of *AB*, or 10¾ in. Piano wire can also be used here to good advantage. Shallow grooves are then cut in the ends of *AB* to receive strong, light cord (fish line is excellent) connecting the ends of both strips, and tied to prevent breaking away under wind pressure. This cord should not be very tightly stretched, as a slight bagginess in the covering along the cord is an advantage. Care should be taken to have each angle exactly like the one opposite to it.

A covering of strong, thin paper or silk is next put over the front or wind side of the frame, the edges being lapped over for about one inch and pasted or stitched, as the case may be. The kite is now tested by balancing on the point of the finger to find the center of gravity, which should lie at the point *F*, slightly over one-third the distance from *A* to *B*. If materially different from this point a new frame should be made.

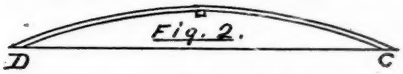


Fig. 2.

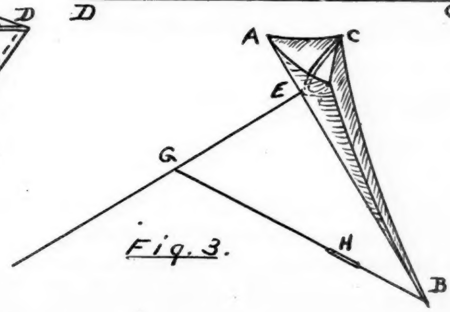


Fig. 3.

The bridle is next to be added and some experimental flying may be necessary before this has been satisfactorily adjusted. The main flying string is attached to the joint of the cross-pieces and should, in flying, form a right angle with the piece, *AB*. The cord *GB*, Fig. 3, should be about 9-10th of the length of *AB*, but the knot may have to be moved towards or away from the kite an inch or two to work right. If the kite whirls around when rising, the knot is too near the kite and needs moving out a little.

Sidewise flying is corrected by adding a slight weight to the end of the strip *CD*, on the side opposite to that to which it flies. Tea lead from tea chests is excellent for this purpose, as but a very little weight is necessary to correct this trouble.

The strain of extra heavy gusts of wind may be thrown off if the cord GB has a strong rubber band inserted at the point *H*, Fig. 3. This will stretch a little, spilling the wind and easing the pressure. A parachute messenger device will be described in a future chapter.

The dimensions for a 3-foot kite are:—The piece *AB*, 3 ft.; *CD*, 3ft. 5 in.; the point *E* is 6½ in. from the top, and the bow has a bend of 4 in. The length of the cord *GB* is 3 ft. 1 in. The smaller size will be more difficult to fly than the larger one.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

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A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

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Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular ssue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

SEPTEMBER, 1905.

Mention has frequently been made in these columns of various phases of industrial education, with a view to emphasizing its importance to the individual worker as well as to the employer. It is now pretty generally admitted by those conversant with the subject that the apprentice system has seen its best days, and can no longer furnish a sufficient number of skilled mechanics to supply the demand.

And the causes operating to produce this result are not wholly or even in large measure due to the labor unions, nor yet are the large manufacturers at fault as a class. Some of the labor unions do have very oppressive regulations, which not only prevent large numbers of willing young men from obtaining a proper training at some trade, but a much larger number of manufacturers offer no opportunity for apprentices. In the latter case the reason will generally be found in the limited or special line of tools manufactured on special machinery which affords no facilities for the proper training of a mechanic.

What shall be done? For mechanics we must have, and those shops with apprentice systems are training no more than will meet their own requirements. A comprehensive system of trade schools would seem to be the answer. With such schools the pupil would make an early choice of the future vocation, and thereafter the whole course of training would be so designed as to produce graduates of sufficient skill and education so that they could, after a short term of shopwork, become efficient workmen.

It is too much to expect that such schools shall be conducted entirely by the State, and that instruction shall be free, as the cost of equipment would be quite beyond the means of most cities and towns. As any such scheme of instruction, to be adequate, must be general throughout the country, some plan of co-operation between manufacturers and educational authorities must be adopted, and herein lies a grand opportunity for the various associations of manufacturers to investigate and report upon the ways to be adopted to carry it out. Only in some such way can the means be provided for giving young men suitable academic instruction and at the same time a proper training in a craft or trade.

The addition of a number of new premiums to the premium list has made it advisable to delay its publication for another month. It will contain many useful tools which subscribers may easily obtain by a little work in making this magazine known to friends.

We are not much given to tooting our own trumpet, but we think we are fully warranted in stating that each volume contains information of value to even the general reader to make it worth much more than the moderate sum required for a year's subscription. A single suggestion may be of much practical value, and the means of securing large financial returns. No one interested in the subjects treated can afford to be without it.

A CHEAP NINE-INCH REFLECTOR.

M. A. AINSLEY.

IV. Figuring a Parabolic Speculum.

So much has been written on the subject of figuring a parabolic speculum, and so well has the matter been explained, that it may seem rather a waste of space for me to try and repeat what has been so often said before; but as I said in my first letter, I am writing for beginners, and I will ask the experts to bear with me if I tell them things they already know much better than I do.

Before beginning the practical figuring of a mirror, it is very necessary to have a clear idea of the effect of various curves upon the image formed by the mirror, and a little trouble taken in mastering the theory will render the practice much easier.

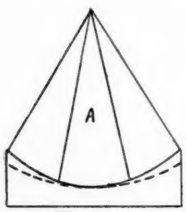


FIG. 1.

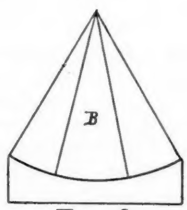


FIG. 2.

Speaking generally, the curve produced by polishing the fine-ground mirror (and I use the word "curve" as practically signifying the same thing as "surface" in this connection) falls into classes, which I shall call A, B, and C.

In class A, the curvature is greatest at the edge, and decreases regularly to the center of the mirror, where the curve is flattest. This is known as the "oblate spheroid", Fig. 1.

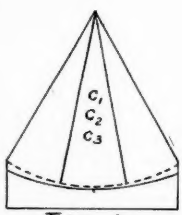


FIG. 3.

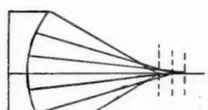


FIG. 4.

Class B consists of the sphere, in which, of course the curvature is the same all over, Fig. 2.

Class C contains the ellipse, parabola and hyperbola —in all of which the curvature is greatest at the center and least at the edge. I shall call these C_1, C_2, and C_3. Fig. 3.

Now let us consider the action of these curves upon a pencil of parallel rays, such as we get from a star.

The effect of classes A and B is to bring the rays falling upon the outside zone of the mirror to a focus of the central rays. This is also the case C_1, Fig 4.

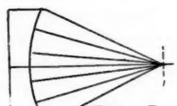


FIG. 5.

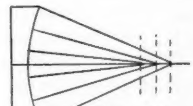


FIG. 6.

C_2 brings all the rays to the same focal point. This is what we want: Fig. 5. C_2 brings the outside rays to a focus further from the mirror than that of the inside rays, the effect being the exact opposite of that of A, B and C_1, Fig 6.

Now the only way, practically speaking, of obtaining a pencil of parallel rays is to utilize the rays from a star; and if we were confined to testing the mirror in the telescope on a star, a good deal of time would be lost waiting for a suitable occasion; so it is necessary to find some test which can always be applied. Before passing on, however, it is well to say something as to the appearance of the image of a star, in the telescope, as given by the various classes of surface.

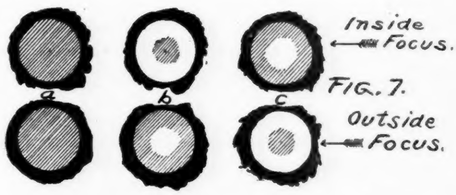


FIG. 7.

In the case of C_2 (the parabola), if the image is focussed as carefully as possible, and the eyepiece is then pushed in or pulled out, the image expands into a circular patch of light which is uniformly bright, and presents the same appearance inside and outside the focus, Fig. 7*a*.

In the case of A, B and C, the image inside the focus will have a dark center, while outside the center will be brighter than the rest of the circle, Fig. 7*b*. C_3, the hyperbola, gives exactly the opposite effect, the patch of light having a bright center inside the focus, and a dark center outside, Fig. 7*c*. It will thus be seen that it is possible to judge of the correctness of the curve

of a mirror by actual testing a star in a telescope; but, as I said, the speculum worker does not, as a rule, care to wait a fortnight for the chance of getting a view of a star, as is sometimes necessary.

The practical method adopted is to make use of an artificial star, formed by a pinhole in a plate of metal, and placed at a curvature of the mirror. Being at the center of the curvature, the image of the pinhole will coincide with the pinhole itself; so it is necessary to move the pinhole a little to one side in order to view the image. This does not practically affect the results except with mirrors of abnormally short focal length.

The action of the various classes of curve, however, is somewhat different from the former case, where the star was at an infinite distance, and the incident rays of light consequently parallel. In the present case they are divergent from the center of curvature, and the difference between the condition of the two cases must be carefully noted.

Upon the new conditions, class A brings the outer rays to a focus nearer to the mirror than the inner, Fig. 4.

Class B brings all the rays to the same focus, Fig. 5.

Classes C_1, C_2, C_3, all bring the outer rays to a focus further from the mirror than the central rays, Fig. 6.

Again, if the image be examined with an eyepiece, as in a telescope, class A gives a bright center outside and a dark center inside the focus. Fig. 7*b*.

Class B, gives the same appearance inside and outside. Fig. 7*a*.

And class C^1, C^2, C^3, gives a dark center outside and a bright inside the focus, as in Fig. 7*c*.

It will thus be seen that, viewed with the eyepiece, C_1, C_2, C_3, gives the same appearance, differing only in degree, and it thus becomes necessary to have some means of determining with certainty when the parabola C_2 is obtained.

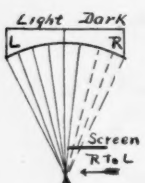


FIG. 8.

FIG. 9

If the eye be brought close up to the image of the pinhole so as to receive the whole pencil of rays reflected by the mirror, the whole mirror will be seen illuminated, and if a screen of metal be brought across the pencil of rays in the neighborhood of the image of the pinhole, it will cut off the light and apparently darken the surface of the mirrors seen by the eye. Its action, however, will be different, according as it is between the mirror and the image or beyond it.

Suppose the screen is always moved across from to left; then if it is within the focus, *i. e.*, nearer to the mirror than the image of the pinhole, it will be seen from Fig. 8 that it will darken the right-hand side of the mirror first; if it is exactly at the focus, the mirror being supposed spherical, the mirror will darken evenly all over, while if outside the focus, the shadow will appear to move from left to right, or in a direction opposite to the motion of the screen, Fig. 9. Thus, if the shadow moves the same way as the screen, the screen is known to be inside the focus; if the opposite way, the screen is outside the focus; while, if the screen is exactly at the focus, the mirror will darken uniformly and with very great rapidity as the screen is moved across.

FIG. 10.

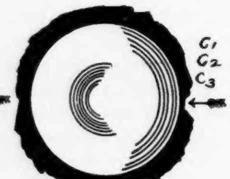


FIG. 11.

This gives us a very accurate means of placing the screen exactly at the focus of the mirror for rays diverging from the center of curvature; and what is true of the whole mirror is, of course, true of any part of it; so that, if the mirror is divided up into zones, and if all the mirror except the zone under examination is stopped out by means of a screen placed over the mirror, it is possible, by observing the point at which the zone darkens uniformly, to place the screen with very great accuracy at the focal point, for divergent rays, of any given zone. Thus the divergence in focus for different zones can be easily measured.

Before proceeding, however, to the actual measurement of the focal point for the different zones, it is as well to make an examination of the three classes, A, B, or C, it belongs to. As before said in the case of class A, the outside rays will come to a focus nearer to the mirror than the inside rays; consequently, if the screen is placed as near as possible to the image of the pinhole, so that the mirror darkens as uniformly as possible as the screen is brought across, the screen will be inside the focus for the central rays, and outside the focus for the marginal rays. Thus the shadow will advance across the mirror from left to right for the center, and from left to right for the margin, the screen being always carried across from right to left. The appearance of the mirror is shown in Fig. 10. In the case of the sphere class B, the darkening is uniform all over; while with class C, since the screen is now inside the focus for marginal rays and outside for central rays, the shadow will advance from left to right for the center, and from right to left for the outside, the appearance being exactly the opposite to that for class A, Fig 11. C_1, C_2, and C_3 all give the same appearance as regards this test, and it is absolutely

necessary to submit the matter to exact measurement, as there is no other reliable way of deciding when C^2, the parabola, is exactly attained.

The method then, is to divide the surface of the mirror into zones by means of card screens placed against it, and to determine, by means of a screen brought across the image of a pinhole, what the exact position of the focus of any zone is.

In practice it is only necessary to measure the position of the screen for the central 2 in., and for the outside inch or so. An examination of the mirror as a whole will show whether the curve is regular, or whether there are any rings; though if the polisher is carefully made, as before explained, rings ought not to appear.

In my next chapter I hope to give the formula for determining when the parabola is attained and the practical details of the testing.

MINERAL POSSIBILITIES OF THE PACIFIC COAST.

The existence of wonderful mineral resources throughout the United States has been shown by governmental and private enterprise, the development of the useful metalliferous minerals is being pushed by miners all over the country, but the complete utilization of many of the most valuable minerals is, as yet in an embryonic stage. Germany, with its scientists, is pre-eminently the pioneer in this field, and as a consequence reaps a rich harvest from minerals obtained in the United States. While at present apparently of limited importance, yet this branch of mineral development is destined to take a leading place among the economic industries of the country.

Recent examples are found in the use of certain rare earths in the manufacture of incandescent mantles, the adoption of tantalum as a filament for the incandescent electric light, the demand for uranium minerals in the manufacture of radium, and the use of various metals and metallic oxides in the manufacture of high-grade tool steel.

The western portion of North America is particularly rich in the extent of its mineral resources, yet, except for the mining of gold, silver, copper, lead, zinc, fuel and iron and their by-products, and some quarrying of structural material, this great natural wealth is largely undeveloped.

In Colorado molybdenite has been developed 1 mile east of Climax, Summit County. The silver and iron ores of Lake County produce considerable manganese which is used in the manufacture of spiegeleisen, and also as a flux by the smelters. Colorado is also one of the chief sources of crude tungsen ores in the United States. The vanadium and uranium deposits of the State are likewise receiving some attention.

Wyoming is credited with producing asbestos, graphite, grindstones, metallic paint, platinum and tin. South Dakota has done but little in the development of these mineral resources beyond the work on its tin mines, and the shipment of considerable spondumene for its contained lithia minerals, and wolframite (iron-manganese tungstate), of which there is considerable in the tin regions.

Montana is attracting attention as an arsenic producer, as the output continues from the white arsenic plant at the Washoe copper smelter at Anaconda, which collects and condenses the arsenical fumes formed during roasting of copper ore. Near Dillon and near Ophir molybdenum deposits have been developed to some extent, and at times some manganese ore has been produced. The grindstone industry is also receiving some attention. Idaho occasionally produces some cobals ore.

Washington has been a leader in the production of arsenic. The Crown Point M. Co., in Chelan County, has marketed crystals of molybdenum, and a talc deposit has been worked seven miles from Marblemount in Skagit County. Graphite has been found near Bossburg. Besides some quicksilver and platinum, Oregon's contribution to the minerals under discussion has been borax, which is found at Chetco, Curry County, as priceite, occurring as pockets in serpentine, and in Harney County, 130 miles north of Winnemucca, Nev., as borate of soda in marsh lands. Nevada, likewise, has produced some borax and also some quicksilver. A tungsten property near Osceola, White Pine County, has been slightly developed. Nevada and Utah are listed among the States producing sulphur. Utah is also credited with producing manganese ore, uranium, vanadium and sodium chloride.

In Arizona metallic arsenic has been found at Washington Camp, in Santa Cruz County, in masses attached to the walls of small pockets in dolomitic limestone. At Troy extensive work has been done in developing and concentrating wulfenite as a source of molybdenum. Near Dragoon, Cochise County, hubnerite and scheelite, used in the manufacture of ferro-tungsten and metallic tungsten, has been mined. Asbestos is being developed in the Grand Canyon of the Colorado.

The U. S. Geological Survey's report on the mineral resources of the United States, from which much of the data for this article has been obtained, credits California with a greater diversity of mineral products than any other State. This includes lithium minerals from San Diego County, asbestos from El Dorado, borax from San Bernardino, Lake, Tehama, Mono and Inyo Counties, chromite, graphite, infusorial earth, magnesite, manganese ores, metallic paint, platinum, pyrite, quick silver, salt, talc and tripoli.

"Mining and Scientific Press."

ELECTRIC BATTERIES; THEIR CONSTRUCTION AND USES.

FREDERICK A. DRAPER.

Principles of Battery Action.

The multiplicity of types and kinds of galvanic batteries and the variety of uses to which they may be adopted, is more or less confusing to the novice in electrical work. These chapters are written, therefore, for the information of those who contemplate steady and experimental work involving the construction and use of batteries, the examples selected being those best adapted to the work for which they were designed and which best lend themselves to construction by the inexperienced in such work.

As an introduction, it will be advisable to briefly present the principles which underlie the action of batteries in general, reserving detail mention of the action of each particular kind for the chapter in which it is described.

It may also be well to state at this time that a battery does not "generate" electricity, although for the purpose of convenient expression, it is frequently so stated. The function of a battery is to maintain a current of electricity through or along a conductor by means of the chemical action set up between two metals, immersed in a liquid possessing a chemical "affinity" for one of them.

The energy with which this combination of metal and liquid takes place, determines the E. M. F. (electro motive force) peculiar to the particular metals and liquids used. Every element possesses a specific amount of latent or potential energy, knowledge of which enables us to calculate the E. M. F. to be obtained from a given combination of elements.

These combinations of elements are always in certain, fixed proportions, which has led to the assigning of numbers to each element, representing the proportion by weight, which the element forms of any compound. These numbers are known as the "Atomic Weights," and represent the relative weights compared with Hydrogen, the lightest of the elements, which has been taken as the unit.

As different combinations of the same elements form different substances, it is evident that elements must be capable of replacing one another. The weight of an element which will replace unit weight of another element is known as the "chemical equivalent," or combining weight. This may be the same or different from the ratio of the atomic weights of the two elements. The ratio of the atomic weights to the chemical equivalent is known as the "Valency" of the element, and is also the number of atoms of hydrogen required to replace one atom of the element.

The substance formed by different combinations of elements are designated by symbols, those of particular interest in these chapters being shown in the following table, together with the atomic weights, chemical equivalents and valencies.

Element	Sym.	Atomic wt.	Chem. equiv.	Valency.
Hydrogen	H	1.	1.	I
Potassium	K	39.04	39.04	I
Sodium	Na	23.00	23.00	I
Manganese	Mg	55.	27.5	II
Aluminum	Al	27.3	9.1	III
Zinc	Zn	65.2	32.6	II
Tin	Sn	118.	59.	II
Iron	Fe	56.	28.	II
Nickel	Ni	58.6	29.3	II
Lead	Pb	206.4	103.2	II
Copper (Cupric)	Cu	63.3	31.7	II
Mercury	Hg	200.	100.	II
Silver	Ag	107.9	107.9	I
Gold	Av	196.2	65.4	III
Carbon	C	12.	3.	IV
Platinum	Pt	196.	49.	IV
Oxyden	O	15.96	7.98	II
Chlorine	Cl	35.4	35.4	I
Iodine	I	126.	126.	I
Bromine	Br	79.8	79.8	I
Nitrogen	N	14.02	2.81	V

This arrangement is also in accord with the electrical condition of each element, electro positive to the ones below, and electro-negative to the ones above it. To illustrate what has been stated we will study the action which takes place in a very simple form of cell.

A strip of chemically pure zinc is placed in dilute sulphuric acid; no action follows. A piece of copper or carbon is also placed in the acid; still no action. The exposed ends of the zinc and copper are allowed to touch or are connected with a short piece of copper wire representing an external circuit; the acid immediately attacks the zinc, the latter is dissolved, zinc sulphate formed and hydrogen liberated in minute bubbles. This chemical action sets up a current from the zinc (anode) through the liquid (electrolyte) to the copper or carbon (cathode), carrying with it the hydrogen bubbles which collect upon the surface of the cathode. The function of the cathode is mainly that of a conductor of the current from the electrolyte.

The chemical action which takes place, as mentioned above, is as follows: The affinity of the electrolyte for the anode and resulting combination and changes has set up a difference of potential between the terminals (electrodes) of the cell, which is equalized by the

current flowing through the external circuit. The current flowing through the electrolyte, breaks up the compounds previously formed, and restores in part the potential energy to the atoms, which again unite with the metal forming the anode maintaining the E. M. F. and a continuous flow of current. The current continues to flow only while the circuit is closed, and ceases as soon as the circuit is broken.

If, instead of chemically pure zinc, commercial zinc be used, action within the cell does not cease when the circuit is broken. Commercial zinc is not sufficiently refined to remove all the other metals usually associated with it in the ore, and the traces of copper, iron, etc., remaining therein, cause the chemical action to be continued, and zinc is consumed without doing useful work. This is known as " local action, " and is undoubtedly caused by the foreign metals which serve as minute cathodes for the flow of local currents.

If the action of this cell be continued by keeping the external circuit closed the hydrogen bubbles will not all rise to surface, but an increasing number will collect upon the surface of the cathode, interfering with the free flow of the current. As the hydrogen bubbles are electro-positive like the zinc, the cathode or negative plate is thus gradually converted into a positive one. This action is known as " Polarization, " and is a source of great loss of constancy in cells of certain types. As will be shown in later chapters, it is possible to select and arrange elements which will overcome this excessive tendency to polarization, while at the same time a current is flowing through the circuit. There are several ways of doing this, the one most commonly employed being the addition of some substance in the cell, with which the hydrogen gas will readily combine. Such substances are known as " depolarizers, " but the rate of their action is dependent upon several conditions. No depolarizer will maintain the E. M. F. of a cell constant with varying currents, the construction of the cell and its size having much to do with the amount of hydrogen liberated and the amount which can be absorbed by the depolarizer.

From what has been stated, it is evident that to obtain a cell giving a high E. M. F., the metal chosen must be one, for which the electrolyte has great affinity, but this is limited by the necessity that little or no action occurred except during the passage of the current. For these reasons zinc is the metal most extensively used, as well as the fact that it is the cheapest metal, excepting iron.

By the consumption of zinc, then, do we obtain electrical energy. It requires but little calculation to show, however, that as a source of energy on a large scale for lighting or power purposes, the cost of materials, and maintainance is prohibitive in competition with dynamos which can supply current at a fraction of the cost from batteries, and far more conveniently.

For such uses as ringing bells, lighting gas or igniting engines or for laboratory experimental work a suitable battery is efficient and easily and cheaply maintained.

HORSE POWER.

How It Compares with that of a Man.

At his very best, the strongest man stands in pretty poor comparison, even with a horse, for hard, continuuous labor. He might perform for a few minutes one-half horse power of work, but to keep it up for any great length of time would be impossible. Thus the gain in forcing horses to do a part of the world's work was enormous. One horse could exhaust a dozen men in a single day, and still be ready for the next day's work.

The measurement of a horse's power for work was first ascertained by Watt, the father of the modern steam engine, and he expressed this in terms that hold today. He experimented with a great number of heavy brewery horses to satisfy himself that his unit of measurement for work was correct. After many trials he ascertained that the average brewery horse was doing work equal to that required to raise 330 pounds of weight 100 feet high in one minute. So he called this one horse power.

This work, however, is not continuous, for the horse would have to back up after each pull to lower the line of the pulley, and thus he would work four hours a day in pulling 330 pounds in the air at the rate of 100 feet per minute, and four hours in slacking up the rope. Consequently no horse can actually perform continuously what is generally called one-horse power. The horse was never born that could tug at a rope for eight hours a day pulling 330 pounds each minute without rest or change. Consequently when we speak of horse-power we refer only to the average work a horse can do in one minute—that is to say, the rate at which he can work.

A strong man might pull half that weight 100 feet in the air in two minutes, but he could not repeat the operation many times without being exhausted.

For all needful purposes the expression of one-horse power is accurate enough, and practically shows the measurement of an average horse's abilities for working. As a rule a strong man can in eight hours work at a rate of about one-tenth of one horse power; that is, it would require ten men to pull 330 pounds 100 feet in the air in a minute, and then slack up and repeat the operation throughout the eight hours of a working day. The world's gain in labor when horses were first employed to help man in his work was then tenfold.

GAS ENGINE CYLINDER COOLING.

To obtain the greatest economy from the cylinder of a gasoline engine, the temperature should be as high as possible to permit of successful running and proper lubrication. This necessitates the use of a cylinder oil which has good lubricating qualities and will withstand a high fire test. The oil should contain but little carbon, and yet have sufficient body and vicosity to maintain a close film of oil around the piston.

When operating on a heavy load and the explosions occur at more frequent intervals, a little judgment and experience are required to keep the cylinders from getting too hot, and an occasional cleaning of the piston and ring grooves may be necessary, as these often become clogged with burnt carbon.

Of the two methods of circulating the cooling water —viz., depending on the difference in temperature of the water or a circulating pump—the latter gives the best results and a more uniform temperature of water can be maintained. When using a natural circulation, the water in the cylinder is apt to remain inactive for a time until steam is generated, when it will be forced over into the tank and a quantity of cooler water will be taken into the cylinder to be overheated, as the previous supply. Such a condition would cause an uneven temperature in the water, with less efficient results. A forced circulation would keep the water immediately around the cylinder from reaching the boiling point, and if a throttle valve were installed, a uniform temperature of, say 165° F., could be maintained.

If the water shows a tendency to get too hot, a freer circulation would cool it to the desired point, and vice versa.

When using natural circulation, a large tank is preferred, and this should be filled to the mouth of the return pipe, so that a slight change in the temperature of the cooling space will cause an immediate flow of water from the tank.

Improper cooling will result in the waste of much fuel, and too cool a cylinder will have the same effect, Thus over cooling as well as over heating should be guarded against for efficient operation of the engine.

HECTOGRAPH FORMULA.

A reader recently asked for a formula for making hectograph pads, and through the courtesy of Mr. H.E. Smith, chemist and engineer of tests of the L. S. & M. M. S. R. R., we are enabled to furnish the following information:

Clear hide glue, 1 lb.

Water, 1½ pts.

Glycerine, 2½ pts.

The glue should be of good quality, and the kind that comes in transparent, light brown sheets, as the white or brown opaque glue does not give as good results. Break the glue into small pieces and soak it in the water over night in a covered vessel. Then melt it in a water bath, and add the glycerine, which should previously be heated to the same temperature as the melted glue. Stir only as much as is necessary to mix the glue and the glycerine, as too much stirring introduces air bubbles, which are difficult to remove. Pour the hot mixture through a cheesecloth bag into the pans.

When the pans are filled and the jelly is still quite fluid, sweep off air bubbles or impurities from the surface with the edge of a card. Let the pans stand 48 hours before using. This formula calls for much less water than is usually required by other formulas since it is preferred to secure the requisite softness by means of the glycerine, which does not evaporate and allow the pads to dry out, as does the water.

In writing the original copy always use hard, glazed paper, and write with hectograph ink. In making the negative, moisten the surface of the pad with a cold, wet sponge, wiping off the excess of moisture. Dry off with a newspaper and let stand for two minutes. Place the original face down on the pad for from one to three minutes, rubbing down to a perfect contact, and then carefully remove.

In printing apply a clean sheet of any kind of paper so that it touches the hectograph at all points, rubbing as little as possible. Never use hot water for removing the negative; as soon as the copies are all made, wash off with a sponge and cold water and dry well with a newspaper. Never let the pad stand with ink in it after the copies are made, and always keep it closed when not in use.—"Am. and Eng. R. R. Journal."

SPECIFIC GRAVITY OF MINERALS.

The specific gravity of a mineral is its weight compared with some substance taken as a standard. Distilled water is taken as a standard for liquids, air or hydrogen for gases, the weights of bodies being proportional to their masses, therefore the specific gravity of a body is equivalent to its relative density. It is the density or compactness of a substance that gives it its weight, the more compact the heavier. If a mineral weighs twice as much as water, its specific gravity is low, being but two. If three times as heavy, its gravity is three, and so on. To obtain the specific gravity of a mineral, weigh a bit of the same, using a fine balance, then suspend the mineral by a hair or silk thread, or platinum wire, to one of the scales; immerse it, thus suspended, in a glass of distilled water and weigh it again. Subtract the second weight from the first by the difference obtained; the result is the specific gravity. The loss by immersion is equal to a weight of an equal volume of water. The water should be at a temperature of about 60° F.

PHOTOGRAPHY.

PASSE PARTOUTS FROM NEGATIVES.

WILLIAM A. INGRAM.

Passe partout binding strip is a very useful article for an amateur photographer to possess. It can be used for a number of purposes, among which may be mentioned masking negatives, binding lantern slides or transparencies, making a defective camera light tight, and sealing up a box of plates or dark slides. With its aid waste glass negatives, when the film has been removed, may be used as covers for photographs, thereby converting them into acceptable gifts, possessing that "personal touch" which adds much to the value of a gift.

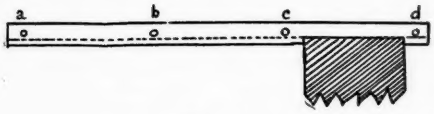


Fig. 1.

One experiences a certain charm in being able to make profitable use of "by products." More pleasure is often derived from the conversion of an over-developed print into a transparency than from a print made specially for that purpose. The same may be said of a glass positive which has been used as a means for obtaining some other result, but is afterwards used as a transparency. Waste negatives, like the poor, are always with us, and a means by which some of them can be used to advantage is well worth considering.

Fig. 2.

The amateur who uses but one size of plate is necessarily somewhat restricted as to the size of passe partout "frames" he can make from his waste negatives. Still if he is not an early beginner he will doubsless be able to find some negatives which can be permanently or temporarily masked, or prints which can be trimmed to sizes suitable for use with the waste negatives he may possess. While it may be rightly considered bad practice in ordinary cases to trim prints to suit a particular size of frame, still there is certainly some latitude admissible where a print is not exhibited as an artistic production, but rather as a photographic memento of a face or place one might wish to preserve.

Before being able to use to waste negatives the film must be removed. The perversity of some inanimate objects is proverbial, and waste negatives are a case in point. Should one inadvertently allow some developing solution to become a few degrees too warm there is a difficulty in keeping the film on the glass, but when one desires to remove the film after it has become thoroughly dry, it is quite another matter. This fact suggests a remedy applicable in some cases. When upon developing a plate it is seen to be useless, increase the temperature of the solution, and the film can be removed without difficulty. If the film has become dry, soak the negatives for several hours in cold water and then transfer to hot, when the gelatine will come away in one piece, or readily dissolve. The glass can be polished with any glass cleaning preparation.

The mounting of photographs for passe partout work calls for no special mention. Mounting card can be purchased at about ten cents a sheet, each of which will cut upwards of 20 four by five mounts. A variety of colors can be obtained, but should anything special be required, drawing paper may be colored to the desired tint with water colors, and pasted over the ordinary mounting card.

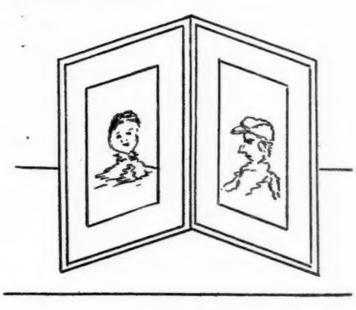


Fig. 3.

To center a photograph, take a strip of plain paper, the length of the glass to be used for a cover, and cut from it a portion equal to the length of the glass to be used for a cover, and cut from it a portion equal to the length of the trimmed print. Divide the remainder into two equal parts, and this will give the width of margin for the sides of the print. Obtain the size of margin for the top and bottom in the same manner. If the print be measured when dry, and mounted wet, an allowance should be made for the expansion of the paper. While this may not be necessary with small prints, it certainly should not be lost sight of with large ones, especially when the margin is narrow, in

which case the difference in the width of margins is only to learned by experience.

To ensure the binding strip being placed correctly in position on the glass the following procedure is advised. Fasten the strip to a board with thumb tacks, gummed side upwards. With a pencil and ruler make a line on the strip, showing the position the glass is to occupy. Moisten a portion equal to the length of one of the sides of the glass on the strip, as shown at Fig. 1, in which *a*, *b*, *c*, *d* are the thumb tacks, and the shaded portion the glass. When this side is firmly fixed cut the strip and follow the same procedure with the three remaining sides. If one has any choice in the matter, glasses should be selected which have perfectly square sides. The mounted photograph must be exactly the size of the glass, placed in position, and the strips moistened one by one and turned over to the back of the mount, making the edges as square as possible, and neatly moulding the corners.

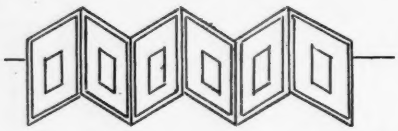


FIG. 4.

Some means of support or suspension must be provided. If the picture is to rest on a table or any similar place, it needs a support. Easels may be bought in a variety of styles which answer this purpose. However, a satisfactory method is to fix a support as shown at Fig. 2, which is simply a piece of stout cardboard hinged to the back of the picture with strips of cloth passe partout binding. A piece of cloth strip, or tape, one end of which is glued to the back of the picture and the other to the support, will keep the picture at the most suitable angle of inclination. If a rigid support be desired, a piece of card may take the place of the tape. When the picture is to be suspended a silk ribbon or cord loop should be firmly glued to the back. If cord be used, it is advisable to unravel about one inch of the ends, in which form it will make a much stronger connection with the back of the picture.

The above remarks apply to pictures treated individually. It is often advantageous to group two or more together, and the different methods of doing this seem almost limitless. Two may be hinged side by side, as shown at Fig. 3, or from the top with a piece of tape to regulate the angle of inclination. So arranged, they will, of course, support themselves. Pieces of cloth binding strip will make an effective hinge and take the place of the ordinary strips along the sides when they are used. More than two may be fastened together in a zig-zag manner, as shown at Fig. 4. This arrangement will sometimes be found convenient with panoramic views, thereby dispensing with the trouble of matching and joining the component parts. Such a combination may be made to fold, and thus occupy very little space when not displayed.

A passe partout photographic calendar makes a useful article. The calendar should have a piece of stout paper for the bottom sheet, which may be fastened to the outside of the glass with passe partout binding.

A pleasing variety of frame is made by using two different colors of binding strip. If one of these colors is white, or any light color that would easily soil, providing it is the color used for the inside border, it is advisable to place it inside the glass, for obvious reasons. This can easily be accomplished by fastening the white strip to the photograph mount, and then using the other colored strips is previously explained. Of course strips of more than two colors may be used if it be thought advisable.

A method of making significant pictures out of comparatively small photographs is to arrange several together. A piece of card is required the size of the whole of any such combination, and the photographs mounted thereon in such a position as the size of the glasses necessitate. The glasses are placed over the photographs and the binding strip used for the outside edges in the usual manner. Strips may be cut of suitable width for using between the different glasses. When such combinations are used the mounting card should be thick to prevent warping. In some cases it may be advisable to use two thicknesses of card. To a certain extent the tendency to warp may be avoided by pasting a piece of paper the size of the photograph on the opposite side of the mount.

An Italian inventor has produced a photographic machine with a film so sensitive that it will record 2000 separate impressions per second.

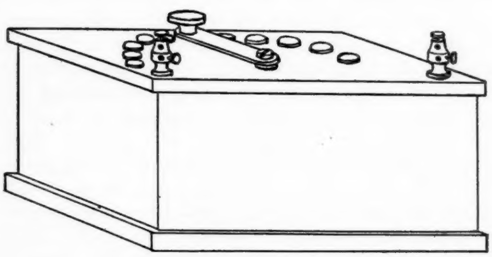
At a recent meeting of the Royal Society of England J. A. Flemming and R. Hadfield gave the results of some of their investigations on the magnetic properties of alloys. They have found that an alloy composed of manganese 22.4 per cent, copper 60.5 per cent, carbon 1.5 per cent, silicon 0.37 per cent, and iron 0.21 per cent, has magnetic properties which are identical with those of materials which are naturally feebly magnetic, and that the permeability is between 28 and 30, which is not much inferior to the values reached for a low grade of cast iron for small magnetic forces. This alloy can also be permanently magnetized. This leads to the surmise that the magnetic properties of the alloy result from a similarity of molecular structure to that of the ordinary magnetic materials, such as iron, nickel and cobalt, and that, if the proper molecular arrangement can be found in an alloy, it may be possible to construct a material which is quite as magnetic as iron, and possibly even more so.

RESISTANCE FOR "WIRELESS" RECEIVER.

ARTHUR H. BELL.

The resistance coil mentioned in connection with the "wireless" telegraph receiver in the August number of this magazine, is not a single coil, but rather a set of coils of very fine resistance wire, wound non-inductively to prevent inductance when the current is passing through them. The construction of such a resistance suitable for distances of not over 25 miles transmission work is quite simple and can be made at small expense.

A wooden box is made, the top and bottom of which is 5 x 7 in. and ½ in. thick. Sides are made of 3-16 in. stock 2 in. wide, and of lengths to give the top and bottom a lap of about ½ in. all around. The bottom is nailed on, and the top attached with round head brass screws after being fitted with the attachments to be described:



With dividers lay off a half circle the radius of which is 2¾ in. and the center 1⅝ in. from one side of the box. Bisect this arc and lay off five points ⅝ in. apart on either side, making 11 in all. Bore holes at these points of a size to receive with a tight fit the threaded part of some thumb screws with flat heads. At the center bore a hole for a brass machine screw with two nuts, which is to hold the arm made of a strip of spring brass 3½ in. long and ½ in. wide.

This arm or lever has a hole at the center end to fit the machine screw with a loose fit, but without play, so that it will turn without binding. Fit a hard rubber knob at the outer end, ½ in. in from the line of the arc. The center screw is placed in the hole at the inner end; one of the nuts is then threaded on till it almost touches the arm, the screw is then put through the hole in the top and the other nut put on and screwed tight, thus holding all firmly, but allowing free movement of the arm.

The coils are then wound of insulated resistance wire to give a resistance of two ohms to each coil. In purchasing the wire, which should be at least as fine as No. 36 gauge, and No. 40 would better, inquiry should be made to learn the resistance of the wire per foot. It is then cut into lengths to give 2 ohms per length. Taking a piece of wire, fold it at the center and then wind it double over a round rod of about the size of a lead pencil, winding it carefully to avoid breakage. The coils, when wound in this way, have little or no inductance, as the current through one-half of the coil neutralizes that through the other half. When the coils have been wound remove the insulations at the ends and solder to the ends of the thumb screws projecting from the under side of the top, one end to one screw and the other end to the next adjoining. The first coil would connect the first and second screws, etc. In seldering it will be well to first deposit on the ends of each of the screws a small bead of soft solder, and then with a blow pipe, heat it up to the melting point, and when just soft enough put the end of the solder, immediately removing the flame.

Two double binding posts are then mounted, one in each corner of the top in line with the ends of the arc. To the left post connect the first thumb screw, and to the right one connect the screw upon which the arm turns. Use covered magnet wire for these connections and solder all of them. The top is then ready for attaching to the box. Double binding posts are necessary, as the local battery wires and wires from aerial and telephone receivers are connected thereto.

The telephone receiver for use with the wave detector, previously described, should be that known as the double head receiver, and should be of very high resistance, 1500 ohms being desirable if one cares to go to the expense of having one as high as that made up. The object of using a double head receiver is to exclude outside sound, so that for one ear may be a dummy, padded to make it sound proof.

The scarcity and rarity of radium will be best appreciated by the following statements: To obtain one kilo or two and three-tenths pounds, five thousand tons of uranium residues must be treated and the process of reduction consumes six weeks of time. Prof. Currie says that for all the work done in Germany and France in the past three years searching for this substance, only about a pound of radium salt has been obtained.

Concerning the amount of radium in America, it is estimated that if all the various grades were reduced to the strength of one million, so-called, there would be between four and five grammes or a half thimbleful, or not more than enough to be heaped on a nickel 5 cent piece.

IRREGULAR IGNITION OF GAS ENGINES.

An essential point in obtaining a strong spark is that a good contact shall be made before the contact points are forced apart.

In practically all make and break igniters, the movable electrode passes through an iron or a bronze bushing and the current must pass from this bushing to the axis of this electrode before reaching the contact points.

Under certain conditions the contact between the outer stem and its bearing, *i. e.*, with the metal of the engine, may be so poor that only a small current could flow; so that on breaking the contact the spark is too feeble to light the gas.

Oftentimes when this condition exists it can be seen by shielding the igniter mechanism from the light. If the contact between the igniter stem and bearing is poor, small sparks may often be noticed around the igniter parts outside of the cylinder.

The cause of this trouble may be due to the presence of too much oil on the igniter bearings; it is, however, more often due to wear and a poor fit between the stem and its bearings; for where the bearing is poor the gases and burnt oil flow through and by reason of the high temperature which the stem reaches after a few minutes running, the oil and soot bakes on it, forming with the "fire rust" a coating that is an extremely poor conductor.

Add to the resistance thus offered, that due to the accumulation of fresh or of burnt oil on the contact points proper inside the cylinder, an amount of resistance is easily reached which prevents the passage of enough current to give a satisfactory spark.

When the stem is flooded with oil a good contact is not formed for the current, as oil is a poor conductor, and when it completely surrounds the stem the insulation is absolute. Yet when well oiled the igniter works better than when the bearing is dry. The prevention of the loss of this oil and the keeping of the bearing in good condition could be obtained by making a valve shoulder near the outside end of the bearing or by surrounding the outer end with a stuffing box and lastly a perfect metallic contact should be had—either by soldering a flexible wire direct to the igniter stem —or to a copper brush pressed against the stem at its extreme outside end. Where such provision is properly made it will be found that an ample spark for all purposes can be furnished with from one-shird to one-half the battery power usually found to be necessary. —"Gas Power."

The cost of a kilowatt-hour of current delivered at the switchboard of any of the larger central stations will not get much below one-quarter of a cent. For the larger New York stations, the figure is around .26 of a cent, and it probably will not go much over one cent for a small non-condensing station.

REPAIRING ASBESTUS GAS LOGS.

HENRY C. FLACKE.

In many houses and offices, at certain seasons of the year, gas fire-place logs are used for heating purposes. After being used for several seasons, however, these logs lose their efficiency, fail to radiate heat properly and give off objectionable odors of the gas. Users frequently wonder at the cause of these troubles, call in a plumber who looks at the connections and generally goes away without making proper repairs. He fails to locate the trouble which, in a majority of cases, is the wearing off of the asbestos covering.

When newly purchased, the asbestos fibres are quite long, from one to one and one-half inches in length, but after being used for a while they become broken and even entirely worn away in places. The gas, in such a case, instead of heating these fibres to incandesence and radiating its heat therefrom, passes away into the air more or less unconsumed, and failing to give the maximum heat.

To remedy this condition, take an old knife or putty knife and scrape off all the asbestos from the face of the log. Get about a pound and one-half of asbestos wool, which will be sufficient for a large surface. Then get about a pint (or pound) of silicate of soda, which, like most everything you buy at a drug store, costs about a dollar an ounce, or fifty cents a gallon; the more you get the cheaper it comes. However, ten or fifteen cents is a fair price for what is wanted. This silicate of soda is a mucilage, and is used to stick the asbestos to the fire face. Pour a saucerful of it and spread your asbestos out on a paper ready for use. With the fire surface cleaned, take a brush and cover the whole surface of the iron with a coat of silicate, using care to keep your hands clean and dry. Pick up a pinch of asbestos and dip it lightly in the dish of silicate and, beginning at the top of the log, stick it on, being careful not to cover up the small flame or gas holes. Repeat this, pinch after pinch, in a row across the top, then another row just beneath, and so on across the plate, row after row from left to right and top to bottom until the whole surface is covered. Put the asbestos on thick; the thicker you can get it on and still have it stick, the better. Now after it is all on you can turn on and light the gas; you need not wait for the silicate to dry. Heat cannot hurt it. Wherever gas flames come through the little holes, open them with a pointed wire or sharp needle. After the silicate is dry the loose fibres of asbestos can be shaken off by lifting the log from side to side.

The maximum working load in pounds that may be allowed on a wire rope equals the square of the circumference of the rope in inches multiplied by 600. Hence a wire rope 4 inches in circumference should not have a load to exceed 9600 pounds.

CORRESPONDENCE.

No. 103. SANTA BARARA, CAL., Aug. 8, 1905.

I would like to ask a few questions relative to using an alternating current to excite an induction coil giving a two-inch spark or larger capacity.

Can good results be obtained by using an alternating current of 7200 frequency and 110 volts?

Can a condenser be used in this arrangement? If so, how is it connected? W. C. T.

Alternating currents are frequently used for coil work, where the coil is large enough to permit of it. If the current is obtained from a commercial circuit, a lamp or other resistance will be necessary, unless the coil is a very large one. Specific directions cannot be given without knowing the primary winding. Consult the manager of the central lighting station on this point.

The frequency you mention is so very high that you have undoubtedly confused it with the frequency per hour. In all probability it is the usual circuit of 60 cycles (120 frequency.)

The condenser should be used and connected across the secondary.

No. 104. KANSAS CITY, MO., Aug. 18, 1905.

I am very much interested in AMATEUR WORK and eagerly read each copy as soon as received.

I would like to have you publish an article on how to build a boiler capable of furnishing steam for ½ to 1 h. p. engine or steam turbine, Also one on the building of a steam turbine of about these powers, and a four pole dynamo with semi-enclosed fields to run direct connected with same.

Referring to the boiler, I think directions for burning crude oil as fuel would be of interest to those living in the sections of the country where such oil is cheap. L. E. P.

We gladly welcome letters containing suggestions like the above. Those mentioned have been receiving our attention for some time, and articles are already under way for most of them. The steam turbine will undoubtedly fill a very important place in the motive world in the near future, and amateurs will naturally be interested to study the principles of their construction and operation through model making. We would also add that motive powers of various kinds will be given a prominent place during the forthcoming year.

No. 105. DAVISVILLE, N. H., Aug. 11, 1905.

I have a wireless telegraph pole which is set upon the roof of my house. The pole is about 28 feet high. I have a telegraph wire on each side of it. Would this pole be all right for sending and receiving messages for a distance of about two miles? W. L. K.

It has been frequently stated in this department that the distance over which wireless telegraph messages may be transmitted cannot be determined from any one part of the apparatus, but is dependent upon the design and construction of all parts, and also the character and elevation of the country in which it is used. An efficient sending station would lose much of its value if the receiving station was not equally as efficient.

In the location and height of the pole the object is to obtain a clear and open interval between stations. as high above the intervening country as convenient, so that influences likely to disturb the transmission of the wave impulses may be avoided.

No. 106. LOMPOC, CAL., July 19, 1905.

I would like to see an article describing how to make a simple water motor of about ⅛ to ¼ h. p., the turning work on same to be done on a lathe like the "Amateur." T. D. L.

Our experience with water motors leads us to believe that to make one which would work satisfactorily requires a metal-working lathe, that same may be perfectly balanced. An unbalanced water-motor is about the noisiest and most troublesome device which can be used for power. To develop ¼ h. p. at 90 pounds pressure would require an 8 or 9 in. wheel, or larger than the capacity of the "Amateur" lathe. We expect to soon be able to offer an efficient water motor as a premium upon such favorable terms as to make it much easier to obtain it in that way than to try and make one.

The driving and holding powers of nails have been investigated by Prof. Carpenter of Cornell, whose experiments seem to show that much more force is required to drive a cut nail a given distance than a wire nail; that more force is required to start a cut nail than to drive it, and that it invariably starts much harder than a wire nail; that the work required to drive cut nails is much more than to drive wire nails; and that the work in withdrawing cut nails is about equal to that in withdrawing wire nails, it being sometimes less and sometimes greater. The relative efficiency which is here considered as the ratio of the work of pulling to that of driving is much higher for the wire nail than for the cut nail. The cut nail bruised and broke the fibres of the wood, principally at the end of the nail, whereas the wire nail simply crowded them apart, and probably did not move them much beyond the point from which they would return by elastic force, and hence the nail would be grasped much stronger per unit of area of surface by the wood. Presenting less surface, there would be, however, less resistance to starting. To see what the effect of change of form would be, a number of tenpenny cut nails were sharpened on the point by grinding to an angle of about 30°, so that the fibres in advance of the nail would be thrust aside and not bruised and broken. This increased the holding power of the nail, decreased the force necessary to start it, and increased the resistance to withdrawal.

GOVERNMENT OWNERSHIP OF RAILWAYS.

Government ownership and reduced rates are popularly assumed to be synonymous. But it may work the other way, says the "Railway Age." After years of increasingly unprofitable operation of the Intercolonial Railway, the Canadian Government has been compelled to announce an increase of freight rates. In 1904 every dollar of earnings cost $1.14 in operating and maintenance expenses alone, with no interest charges on the heavy investment, and for 1905 the excess of expenses over receipts will be still larger. The taxpayers are tired, and an influential journal notifies the prime minister that "the people of the country will not much longer continue to pay from four to six millions a year out of their taxes to keep in operation a railway that has cost 80 millions of dollars for the benefit of the political machines." Per contra, the unhappy ministry will be denounced still more roundly along the lines of the Intercolonial for raising the rates. It is the popular assumption in this country that railway charges are unnecessarily high, and that government ownership would mean far lower rates for transportation, and also large returns on the public capital invested. But suppose the Government roads were unprofitable? Even with the rates which are declared to be excessive a majority of the roads in this country have been bankrupted; a fractional decrease in rates—so small as not to be felt by shipper or consumer—applied to the principal articles of freight—might bankrupt many roads now. If Government owned the roads, sweeping reductions would be demanded by every locality and interest, and when the earnings got below expenses the experiences of Canada with its unprofitable railway, would probably be repeated, on a vastly greater scale. The country that has all the benefits with none of the risks and losses of railway ownership, may consider itself fortunate.

CELLULUSE FROM CORNSTALKS.

After extensive and elaborate experiments by the United States Government, it has been discovered that cellulose in considerable quantities may be extracted from corn stalks, and the industry promises to grow to gigantic proportions almost at once. Cellulose, as is well known, is the essential constituent of the framework or wall membrane of all plant cells. It is a secretion from the contained protoplasm, but in the advancing growth of the plant the walls become incrusted with resin, coloring matter, etc. It composes the cells of a honeycomb. Cellulose, by reason of its peculiar properties, is being largely introduced into shipbuilding, as, due to its property of swelling rapidly when wet, it prevents leakage through holes below water line. Up to the present century the only available material from which cellulose for this purpose could be prepared in sufficient quantities was the cocoanut shell. The ground fiber of the cocoanut shell, with a small percentage of the original fiber, constituted the cellulose of commerce.

BOOKS RECEIVED.

THE NAVAL CONSTRUCTOR. George Simpson, M. I. N. A. 585 pp. 6½ x 4 inches. Flexible leather. Price $5.00. The S. Van Nostrand Co., New York.

The rapidly increasing importance which naval architecture and construction is assuming in the curriculum of technical schools and which will become even more prominent with a more general application of the steam turbine as the motive power, makes any book written by an author of such wide experience as Mr. Simpson, of the greatest practical value. The above handbook has been prepared with the object of supplying a ready reference to those engaged in the design, construction or maintenance of ships,—such a work as should give simply and concisely information on most of the points usually dealt with in the theory and practice of marine architecture, and in addition much that is new and original, all of which is in line with present day requirements.

PHOTOGRAPHIC AMUSEMENTS. Walter E. Woodbury. 114 pp. 9 x 6 inches. Paper. Price $1.00. The Photographic Times Pub. Asso., New York.

The purpose of the author in writing this book was not to prepare an instruction book of photographic practice, but to present the novel and curious effects that can be obtained by the aid of the camera. It requires but a slight examination of its pages to show that the author has been eminently successful. Here we learn how our fishermen friends are photographed as witnesses to their piscatorial skill, how a man can wheel his own head in a wheelbarrow, become a tall, lean man, or a short, fat one, and numerous other photographic "stunts," which prove of interest to the amateur photographer who likes to experiment.

Steel as a material of construction has made its way because of its strength, its resistance to the elements, or because of its economy of space, or for other resons appealing to the engineer. It is evident in the apparently increasing dangers of crowded modern life, that steel will come into increasing use because it affords greater security to human life. In the past twenty years the metallurgical engineer and the mechanical engineer have worked together to cheapen it so that the civil engineer could employ it more freely. It is safe to predict that a still larger factor in the steel tonnage of the future will arise from uses which are optional today, but which public sentiment will then make compulsory.—"The Iron Age."

SCIENCE AND INDUSTRY.

Every railroad wreck that has as one of its horrors the burning to death of imprisoned passengers, calls attention afresh to the steel car and the larger place it must take in the construction of passenger as well as freight cars. The resistance of steel to the terrific impact of the train recently derailed at Mentor, Ohio, might have saved a number of lives. Certainly with steel cars there would have been no kindling pile and no charred bodies. The purchase of steel cars for the New York Subway was prompted chiefly by the desire to make the best provision against fire, derailment and collision. The latest of the tube railways in London is equipped with steel cars for the same reason. It would seem that the large death list from fires on steamers, in public halls, hotel buildings and in railroad wrecks in the United States in the past eighteen months have given sufficiently terrible emphasis to the need of a larger use of non combustible materials for buildings, cars and vessels.

By resistance, electrically speaking, is meant something placed in a circuit for the purpose of opposing or resisting the passage or flow of the current in the circuit or branches of the circuit in which it is placed.

Intense cold, as is well known, burns—if we may use the term—like heat. If a " drop " of air at a temperature of 180° below zero were placed upon the hand it would have the same effect as the same quantity of molten steel or lead. Every one who has the care of horses ought to know the pain inflicted by placing a frosted bit in a horse's mouth. It burns like hot iron.

Heating the feed water of a boiler will save from 25 to 30 per cent of the fuel. A good heater will utilize the exhaust of the engine, which will raise the feed water almost to the boiling point.

At sea level the rending force of black powder is deemed better for coal mining than dynamite, the former breaking it into convenient shape, the latter tending to waste by shattering it into dust.

The Atchison, Topeka & Santa Fe Ry. is making a series of experiments with an oil burning locomotive on its lines in Kansas. A very heavy crude oil which, it is claimed, cannot be refined, is being used. Particular interest is attached to these tests because of the fact that this company has mines of coal from which it gets very cheap fuel for its lines in Kansas, and if the oil proves to be cheaper and safer in this case, it will have a large influence in extending its use for locomotives in other parts of the country.

What must surely be the oldest steam-engine in the world is described by a correspondent of the American Machinist. It was still working, when the writer came across it in 1899 or 1900, at the Douglas Bleachfield, Forfarshire, and was considered by experts to be one of the best examples of Watt's earlier work. It was originally built for a Newcastle firm, and after many years' work was sold into Scotland in 1797, where it saw a hundred years of active service. The fittings of the machine include a good deal of leather and buckles, and a quaint story was told of a machinist who was once called in to do some repairing on it, in the absence of the usual man. This man thought he would be all right if he took a hammer, a monkey wrench and a chisel with him. When he saw all the straps, harness, buckles, etc., he called up the superintendent and said to him, " Hi, mister, it's a saddler you want, and no an engineer, for this job!" The machine is now enjoying a well-earned retirement at Dundee.

According to documents found in the archives of Genoa, the discovery of America by Columbus cost a little over $7000. The fleet of Columbus was worth about $3000. His salary was $200 a year.

When a column of liquid is heated at the bottom, ascending and descending currents are produced. It is by these that heat is mainly distributed through the liquid and not by its conductivity. These currents arise from the expansion of the inferior layer, which, becoming less dense, rise in the liquid, and are replaced by colder and denser layers. The mode in which heat is thus propagated in liquids and gases is said to be by convection.

Red lead, the most important of the oxides, is made by heating litharge in a reverberating furnace, the metal's color being changed thereby from yellow to red.

The Bessemer process of steel making was invented in 1856, but it was not until 1876 that open hearth steel has been introduced.

The operation of producing liquid air is, air compressed to 1200 to 2000 pounds to the square inch; passed into receptacles where it is purified by separating the moisture, oil, etc., and passed thence into expansion chambers and through coils of pipe of considerable length. During the process it becomes intensely cold, reaching finally 312 below zero, at which point it becomes liquid. It is drawn off into insulated vessels, where it is kept for days, gradually lessening in quantity until it is entirely evaporated.

Kerosene is the main product of the distillation of petroleum, the crude domestic oil yielding up to 75 per cent of its weight in kerosene.

A good mixture for use as a slush to prevent the rusting of machinery is made by dissolving one ounce of camphor in one pound of melted lard; skim off the impurities and add enough black lead to give the machinery carefully, smear on the mixture. It can be left indefinitely, or if wiped off after twenty-four hours will prevent rust for some time. When removed the metal should be polished with a soft cloth.

Carborundum is the result of the fusing of coke and pure silica (quartz) in the electric furnace, and is at present only done in the United States at Niagara Falls.

Concentrate ! A one inch stream at close range is more disastrous than a three inch torrent at one hundred yards.

Henry S. Pritchett, president of the Massachusetts Institute of Technology, says: "To the great essential qualities of character, which good men must have —energy, sincerity, devotion, moral courage, unselfish purpose—must be added that rarest of all human endowments which we call common sense; that is, the ability to think straight, the power to see both sides of a question."

If the devious and important processes of painting putty plays an indispensable part. It comprises the material and process of making good the existing defects of wood and metal, and without it the painter would find himself in a sorry plight. It may be said, in good truth, that there is positively no limit to the putty mixing formulas in use, but for ordinary purposes of an average grade of work, the formula next following is probably best adapted: Dry white lead, three parts; bolted whiting, one part, mixed to the proper working consistincy in equal parts of quick rubbing varnish and coach japan. Some thoroughly good painters prefer to vary this formula to the extent of omitting the whiting. In either case the putty may be accepted as reliable, if kneaded completely and worked out in mass fine and smooth. Such a putty under proper drying conditions should sandpaper clean and without tearing up in texture at the expiration of 48 hours. A slower but more elastic putty is made of three parts of oil ground lead and two parts of dry white lead, mixed in elastic rubbing varnish and gold size japan.

Meerschaum is a mineral of white or grayish color and is a hydrous silicate of magnesia. It is of soft, earthy texture, has the appearance of chalk, has a hardness of 2.5 and a variable specific gravity, very light, however, as when dry it will float on the water. An impression can be made in it by the finger nail and has a smooth feel. The principal source of the mineral is Asia Minor, where it occurs in vein form and mined at places from pits and horizontal galleries in a much similar way to coal. When first brought to the surface it is white with a yellowish tint, and is covered with red clayey soil. It is sold as brought from the mine. Its only treatment is in cleaning and drying, which takes place in the open air in summer time, requiring five or six days of heat to perfectly dry. Meerschaum has been found at a few places in the United States, but sparingly in each instance. It has been found in serpentine quarries in Chester County, Pennsylvania, in Delaware County, Pennsylvania, and at Richmond, Massachusetts, and in Utah and New Mexico. Its main use is in the manufacture of pipes and holders for tobacco smokers. The heavier mineral is the most valuable. Meerschaum of very light weight is too porous for producing the best pipes. Meerschaum is a most valuable commodity, and a deposit located anywhere in the United States would be of much value.

TRADE NOTES.

The new catalogue of files and rasps. manufactured by Henry Disston & Sons, Philadelphia, Pa., should be on the desk of every teacher of metal working in the manual training schools of this country. It is very completely illustrated and a valuable source of information to any user of files. We also note the statement contained in the catalogue that this company make their own steel, and are thereby enabled to secure an absolute uniformity of quality.

Kendrick & Davis, Lebanon, N. H., in response to a demand from jewellers and others who have occasion to do electro-plating of small articles, have got out their No. 9 Generator with windings especially adapted for this work.

Amateur boat builders who contemplate building a boat during the coming winter, should secure the catalogue of the Brooks Boat M'f'g. Co., 4208 Ship St., Bay City, Mich. It contains a wide variety of designs for which the company furnishes patterns and directions for building. Those who have no experience in boat building will find their help to be invaluable, and even experienced builders use them, as they effect a large saving of time in getting out stock.

The drafting-room tables and equipment manufactured by the Economy Drawing Table Co., 1309 Utah St., Toledo, Ohio, are of the most durable and finished character. The designs are up-to-date in every particular, and purchasers of these goods have only words of commendation for them.

In equipping rooms for metal working, the vises made by The Charles Parker Co., Meriden, Conn., should not be overlooked. For quality of material, workmanship and design, these vises are unequalled. Few large manufacturing plants of the country but have these vises, and the lead of the experienced buyer and user can profitably be followed by others.

The rapid sketching device made by the Universal Drafting Machine Co., Cleveland, Ohio, is a practical aid to laying out work or designs which should receive the attention of every designer or engineer. It is of sufficiently light construction so that, while strong enough for the work, it will not tire the user. The ease with which any angle may be obtained makes it a valuable time saver.